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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

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1920 Uneventful in Engineering

THE year 1920 was an uneventful year in civil engineering—in the construction industry. In all lines, except highway work, construction was below normal. Projects outstanding either in magnitude or design were rare.

Though there was little in the way of construction, the railroad field may be accorded first place in the importance of the year's developments. The roads were returned to their owners for operation, new rates, designed to give a 6 per cent return on investment, were put into effect, and efficiency greatly increased by the co-operation of the public with the very intelligent efforts of the management. But much remains to be done to bring the railroads up to the demands of traffic, and this will require expenditures that will make work for every branch of the construction industry.

Highways take second place. No material abatement of construction activity in that line is to be expected, though the thinking has reverted from expensive to cheaper forms of construction.

With this emphasis on railways and highways has come new interest in the design and operation of rail and water terminals.

In actual accomplishment, judged by magnitude of construction and interest of design, first place would be accorded the field of hydraulics. A satisfactory water-power bill, after almost a decade of bickering, was passed by Congress. Excellent progress was made on the remarkable Miami Conservancy project. On the American side at Niagara Falls record-breaking reaction turbines of 37,500-hp. capacity were put in operation, while on the Canadian side work continued on the great Chippewa project. On the Pacific Coast projects were started or carried along on which a number of records will be broken. These include a 220,000-volt transmission line, an 806-ft. head on a reaction turbine, 40,000 hp. from a single vertical-shaft reaction turbine and 30,000 hp. from a double-overhung impulse wheel under a 1,008-ft. head. At Muscle Shoals work progressed on one of the half-dozen largest construction projects in the United States—the Government's big hydro-electric scheme.

In structural lines the organization of the new joint committee on concrete and reinforced concrete must be recorded. Among miscellaneous projects was the inception of the work on the New York-New Jersey vehicular tunnel.

In engineering education there were no notable developments, but the schoolmen generally have an inquiring and receptive attitude that augurs well for future development.

In the field of society organization there is to be recorded the launching of the Federated American Engineering Societies, the very great growth of the American Association of Engineers and the rounding into shape of the Associated General Contractors.

Licensing has entered the stage of general acquiescence.

By and large, however, the year has been relatively uneventful. In the construction industry it has merely repeated the general business experience of painful progress toward a more normal and sounder footing.

The Benefits of 1920

BECAUSE the year 1920 was so unsettled, we are likely to overlook its constructive effect.

Its tendency has been to bring us back to a saner, a more conservative basis. The situation, on the whole, is sounder.

Brief consideration will show the contrast clearly:

The extravagant buying in 1919 has been replaced by the conservative buying of the last six months of 1920.

The over-extended credit situation of 1919 and the early months of 1920 has been replaced by the deflated condition of the latter half of the year.

The labor radicalism of the war and of 1919 has largely disappeared. Wage reductions have been accepted. The talk of industrial control has ceased. There is the beginning of co-operation between labor leaders and engineers on a sound industrial program.

The attitude of employers is reasonable. They have not taken advantage of the present opportunity, due to unemployment, to force down wages sharply. On the contrary, there is a desire, if production will justify it, to continue present wage levels.

All these are evidences of calmer, sounder thinking.

The construction industry, in company with the rest of the community, has been going through the same settling-down process. Among engineers there is a return to serious thinking, to the study and analysis on which sound design—and therefore sound construction—are based. The conservative swing in the American Society of Civil Engineers is an indication of a more settled point of view.

Contractors take a calm view of conditions. They

are not busy, but the outlook is improving. Labor is plentiful and more efficient. Credits are easier. Materials are coming down in price. Transportation conditions promise to be better next season.

Only the members of one of the three major branches of the construction industry—the manufacturers—are still in a badly disturbed condition. But the reason is obvious. The slackening of business has left heavy inventories on their hands. The contractor, comparatively, is in an ideal position. He has no inventory, and his plant is paid for in good part. It may not be earning, but the financial burden it imposes is relatively small. Nevertheless, manufacturers are gradually getting rid of their stocks and the spring trade will clear up the difficulty.

On the whole, the construction industry is settling down, and as a result of the deflation process of 1920 is in a sounder position today than it was a year ago.

Troubles Not Yet Over

IN APPRAISING the benefits of the latter half of 1920, there is no desire to carry the impression that all of our difficulties are at an end. We are not yet "out of the woods"; indeed, we are far from being out.

For some years yet the process of working to lower levels will be in progress. That will occasion repeated disturbances, for it requires budget readjustment by every business enterprise and every individual.

We have made only a small impression upon our war debt. Our government expenditures continue at an extravagant figure. Taxes are high and probably must go higher.

In Central Europe there is little improvement, while the exchanges with the whole of Europe are a serious detriment to the marketing of our cotton and grain crops. The first step is now being taken in broad-scale export-trade financing. It is, however, but a start and unless followed by further vigorous efforts is not calculated to have any considerable immediate effect on the situation. As long as Europe cannot buy our goods, we are bound to suffer.

Even the end of 1921 will not see a permanent stabilization. The dislocation caused by the world war was too great to be wiped out in a three-year period. All we can hope to do by the end of the present year is to make a further considerable step in the readjustment process.

The Outlook for Construction

IN a time of stress we are especially concerned about the future. The question today is—What of construction next year?

Prediction must rest on experience. Fundamental conditions are sound. Crops have been large, the financial situation is well in hand, there is a large withheld demand.

The present depression, as a result, should be short lived. So argue, in fact, many of the country's shrewdest students of business. They expect the present inaction to continue for some months, with revival in the spring and good business in the latter part of the year. Such, for example, is the view of Professor Persons, of the Harvard Bureau of Economic Research. Other students, such as Judge Gary, look for steady improvement but do not attempt to fix a date for the definite initiatio of a forward movement. In general, the concensus of opinion, such as is expressed in the *Review of Reviews'* symposium, inclines toward the expectation of a fairly active year with a steady upward trend.

These views relate to general conditions. Have the engineer, the contractor and the manufacturer in the construction field equal reason for courage and calmness, even for optimism?

A brief review of conditions will help in forming a judgment.

There has been no normal construction year since 1916—if, indeed, that could be called normal. The whole country is under-built. There is work ahead for many very busy seasons.

Whether projects will be undertaken—how much will be undertaken at once—depends on the attractiveness of conditions; and they are decidedly better now than they have been for four years.

In 1920 materials prices were high; labor scarce, expensive and inefficient; transportation disorganized; the financial situation stringent. These were serious bars to the effective conduct of construction work.

By contrast the indicated conditions for 1921 are:

Lower wages; ample and more efficient labor.

Lower materials prices.

Better transportation.

Easier money; an improved credit situation.

Materials prices, it is true, have begun to break only recently and recessions thus far have been small. But the tendency is downward. Transportation conditions should be better though we must not expect them to be equal to a pre-war normal. That would be too much to expect.

Certainly these favorable conditions should tempt owners and public agencies to proceed with construction. The factor holding back work is the expectation, always an accompaniment of a falling market, of still lower prices. But with demand pressing hard on facilities and with a set of conditions more favorable than those of 1920, or 1919, it appears to us inevitable that a good volume of construction will be forthcoming. Knowledge of conditions will spread during the winter. The spring should see an active construction revival.

Engineers and contractors, then, have as much reason for optimism—or at least for calmness and courage—as those who base their views on general business conditions.

Revival in Railroad Work

SOME contractors are basing high hopes on a large revival in railroad building. In this hope we cannot share. Highway work there will be—a lot of it; there will be municipal and other public-works construction; there will be building work. But in railroad work the lagging pace of these many lean railroad years is not likely to be much accelerated. The railroads will have to be assured of the 6-per cent standard return before they will be able to finance improvements on a satisfactory basis. The new rates are not producing up to the mark set. Therefore the construction program will be limited to bare necessities.

As T. De Witt Cuyler puts it in his article in this issue, "Capital expenditure programs for 1921 will of necessity be directed mainly at removing situations which prevent the existing railroad lines from carrying maximum traffic over the existing trackage."

Intimations to the same effect are to be found at the conclusion of the article by Mr. Parmella on maintenance.

New York's Building Scandal and Organized Contracting

FOR over two months a New York State legislative committee has been inquiring into the operations of the building industry of New York City. The situation, apparently at first merely local and concerned with labor organization, has developed into a matter of nation-wide import. Not only are there labor rings, but rings of contractors and even tighter rings of supply dealers. So flagrant were the operations and such is the suspicion that similar conditions obtained in other cities that the Calder Senatorial committee has secured power from Congress for a nation-wide investigation of the construction industry.

The situation, therefore, is now far beyond a matter of mere local importance. In particular does it concern every one connected with construction in any manner or anywhere in the Union.

Coming just at this time, too, the scandal points to a great opportunity for organized contracting.

In brief, three things have been shown at New York:

1. That the building-labor organizations were under the control of a single individual who brazenly levied tribute, for his own pocket, upon contractors and labor alike.

2. Subcontractors through the operations of "open-price" associations have been in a position to do collusive bidding. Pleas of "guilty" on indictment indicate that in some cases, at least, advantage was taken of the opportunity.

3. General contractors, even some of nation-wide reputation and operation, have bowed to the rule of the labor boss and have either directly paid tribute to him, or have done so indirectly by employing only such labor as he approved of. The boss, of course, got his return in the latter cases by tributes upon his closely controlled labor groups.

4. Materials dealers—possibly also materials manufacturers—through "open-price" associations and other forms of agreement have collusively raised prices—have raised them to figures not warranted by costs nor by the law of supply and demand.

The sum total of these operations has been to increase materially the cost of building operations in New York City.

Particularly is it important to note that a mechanism—the "open-price" association—designed to allow the exchange of price information while removing those operating under it from possible punishment under the anti-trust laws, was the favorite means for carrying on the price-raising activities of the materials dealers and the subcontractors. Obviously, there are advantages accruing to industry from the work of industrial associations. Obviously, too, as soon as price exchange is started or price discussions are entered upon there is danger that price raising will result. This is exactly what happened at New York City.

Manifestly, the chief concern of the construction industry is in measures that will prevent a repetition of these conditions. Sole reliance on legal measures will prove futile. The result of the present investigation will be the punishment of some of the participants and the temporary suspension of the pirating. In a year or two the disclosures will be forgotten, new rings will begin to form, and in four years' time, at the outside, the conditions can well again be repeated.

Engineers and architects are not likely to be effective in preventing this sort of thing. They do know of it, many of them knew the conditions that obtained at New York, but their organizations—unless possibly the new federation—are not of the type to take up a matter of this kind and fight the case through.

The contractors alone, as we see it, can prevent similar conditions developing in the future. To do that requires widespread sources of information, financial strength, and an organization of nation-wide scope. All of these things the contractors either have actually or potentially. They, more than any other single interest in the construction industry, know what is going on. They employ the labor, they employ the subcontractor, they buy the materials. Their sources of information extend to every city in the land. Their combined financial strength is large. Their influence is nation-wide.

Unto these things must be added a strong organization and strong leadership. Now, for the first time in the history of the contracting interests of this country, that strong organization and that strong leadership seems to be forming. We refer, of course, to the Associated General Contractors.

Of course, this is not the only one of the great opportunities before the association, but it is a big one—and it looms large just as the association is apparently settling down in organization and preparing for vigorous functioning.

For the best interests of the public which buys construction, whether as individuals, private corporations or public authorities, the Associated General Contractors needs to grow into a thoroughly well-knit fighting agency. If it becomes that it will place the construction industry of this country in an enviable position, to the benefit of the industry itself as well as of the public.

Am. Soc. C. E. Activities

NO ACCOUNT of the year's doings would be complete without brief mention of the activities of the American Society of Civil Engineers. The year has been an unusual, even if unfortunate, one. Discussion and contest have waged over management policies and mechanism. Have not the main purposes of the society been neglected?

Among broadminded men the purpose of discussion is to bring out and to clarify to themselves and to others the true merits and demerits of proposals. In the society's discussions last year, the contests were taken as the medium for personalities, for casting suspicion on the motives of opponents, for partisanship that has been a reflection on the society and on the members participating in the propaganda on both sides. Men otherwise fair have in the heat of contest given their opponents credit for not one shred of honesty. They have deluded themselves into belief that the opposition's motives are entirely selfish—a desire to control the society for personal benefit rather than in the interests of the society as a whole. Both sides make the charge and both are equally wrong. Disinterested onlookers know that both parties honestly believe that their victory would be for the best interests of the organization and that they place the society's interests first.

The stage is set for an annual meeting that may be unpleasant. We hope that the rabidness displayed in private discussion and printed documents will have spent itself before that time, and that the meeting may be a man-to-man, fairminded, considerate discussion of whatever topics are brought up.

Benefits From the Strife

AFTER so much strife there should accrue to the American Society of Civil Engineers some benefits for the time and energy expended. Surely, from the standpoint of technical work even a calm discussion of internal policies and mechanism for a whole year would be deplorable. Under the frenzied temper of the contest, the effect upon the society's technical wellbeing has been mischievous. It has rendered lukewarm those whose interest in the society was mainly in its professional and technical service. "A plague on both your houses," as one of these members has expressed it.

The only benefit to be expected from the year's discussion should be agreement upon some ground common to the two factions. This result has, we believe, been achieved, even though there may need to be further discussion before the agreed-upon essentials can be expressed in satisfactory constitutional changes. These essentials, which both sides approve, are that the choice of the districts for their directors must be respected, and that the local sections must be developed into virile elements of the organization. Now that the conservative leadership has accepted these essential principles that which remains is agreement upon precise method and wording.

Another result of the year's strife seems to be that the "stand-pat" element is definitely out of a place of power. When the organization again functions normally it is to be expected that there will be a conservative element, but this conservative element, if it be true to its pledge, will not be hidebound but will work for a widening and intensification of the society's work.

The return to a normal functioning is much to be desired. New vigor needs to be put into committee work and there needs to be a papers committee based on the theory of active effort to secure papers representative of the important advances in every branch of civil engineering rather than upon the old theory of indifferent solicitation of papers or of waiting for them to be sent in voluntarily.

Even as the year 1920, despite its disturbances, has been of benefit to the country and the industrial community, so in the American Society of Civil Engineers has it, through turmoil, produced good results. There is near-agreement on the essential changes required, there is less difference in outlook, in program and in aim between the two chief articulate and active groups in the society. A moderate, sane progressivism seems assured.

The Federation

FOREMOST among the engineering society activities of the year has been the launching of the Federated American Engineering Societies. Historically, it is a development from the occasional inter-society committee work begun some years ago. The need for a permanent committee being apparent, Engineering Council came into being, and that, failing to bring the local societies into co-operation with the nationals, led in turn to the federation.

How serious is the failure of the civil engineers to join it only the future can tell. The three major societies and the locals which are in the organization are fully capable of giving the plan a thorough test.

That there is need for functioning through some clearing house or centralizing organization is fully conceded. Failure of the civil engineers to join was not due to lack of appreciation of the need for some unifying body (for that was strongly endorsed in the questionnaire early last year) but rather to traditional conservatism, to the weakness of the presentation made by the sponsors of the federation, to the failure to make clear in the federation's constitution the determination to keep out unqualified organizations. Had there been a representative of the conservative element of the Am. Soc. C. E. on the conference committee, ideas might have been interjected into the plan that, without changing materially the fundamental idea of federation, would have won the support of many of the conservative members. There was too much "progressivism," not only as to the federation plan itself, but as to the personalities responsible for it. The federation matter was bound up with an intra-society quarrel.

Despite the adverse decision, however, on entrance into the federation, it is clear to everybody who wants to be fairminded that the failure of the federation would be serious for the engineering profession. It would put off indefinitely the day when all societies would co-operate harmoniously. Eventually that co-operation will come. Some method will be found by which the civil engineers will be brought into the fold, even if there must be, to accomplish that object, radical change in the organization's constitution.

We look to the federation, therefore, to become the eventual nucleus of any co-operative movement. Should it fail, there would be no other alternative than the separate establishment or development of a welfare and civic-activity body. Of the latter proposal there are many supporters. For the present, however, the majority of the strong elements in the profession have pinned their faith to the federation.

The A. A. E.

PROGRESS of the American Association of Engineers has been notable during the year. The membership has increased from 10,000 to 24,000, making it by far the largest engineering society in the country—nearly double the size of the next largest. With growth has come a softening of the antagonism hitherto shown toward the association by many prominent engineers in the older national societies. That softening has not been due to mere recognition of the power of the organization, but to an awakening appreciation that the association is not radical, that the charge that it was a union was without any basis. The study by Engineering Council of compensation and of registration—paralleling some of the association's work—may have had something to do with the change in attitude. But whatever the reason it is a fact that the A. A. E. is now mentioned in conservative quarters without the former denunciation and display of antagonism.

Internally the association is rapidly maturing. Large-scale experimentation, necessary at first, is being replaced by definite operating practice. The intensive character of chapter development—with paid secretaries in half a dozen strategic centers—is particularly worth noting.

With the 50 per cent increase in dues, which has been voted, the association's influence is bound to increase. The year 1920, however, is a landmark not soon to be rivalled, for it records the real finding of itself by the association and its wide recognition, even by former antagonistic circles, as an element that cannot be neglected in professional organization.

N. Y. Section, Am. Soc. C. E.

THE New York Section of the American Society of Civil Engineers is worth recording as a real accomplishment of the year. It is a local organization, it is true, but it has a national import, for if it be vigorous it will not only cast luster on the society in the nation's metropolis, but will help to solve the problem of weak and uninteresting meetings, which has been the bane of the New York gatherings for these many years. Fortunately, it has been vigorously manned and is vigorously functioning. It has held three meetings. Each one of them was a record breaker, not merely in attendance but in the timeliness and technical value of the discussions. Very properly, the meetings concerned themselves with large local problems, obviously a very proper point of attack for a local section. It is not too much to say that the coming of the New York section has put new life into the society in New York.

Fortunately, too, the section was launched without any of the partisanship which might easily have been injected into it. The judicious selection of officers—all of them men of unusual ability—representing a good balance between the various points of view has resulted in an entire absence of that partisanship which, unfortunately, at the minute is afflicting the society at large.

From every point of view, therefore, the happy inaugural of the New York section is a civil-engineering society event of 1920 well worth recording.

Licensing

THE year 1920 brought to some finality the question of the registration or licensing of engineers. Until the beginning of this year there was constant debate on the advisability, on the advantages and disadvantages, of licensing.

Within the twelve-month, however, the discussion has given way to calm acquiescence or indifference on the part of former vigorous opponents. No longer are the merits and disadvantages discussed. The outstanding fact is that licensing is now accepted as inevitable and that its extension to many other states, beside the eleven which have it, is to be looked for.

Such being the case, study from now on will be directed toward the administration of the various measures. The problem of reciprocal relations between states will come to the fore, codes of practice will be built up and the administration of the acts refined. We are, to use an engineering simile, going from the field of construction to that of operation. There will result from the operating experiences material for the modification of existing statutes.

Somebody, and it will naturally be a licensing committee of the Federated American Engineering Societies, will need to follow the experiences closely, to correlate them, to draw conclusions, and to place the experiences and conclusions at the disposal of officials administering the laws and also of engineering societies in states where changes are needed. The conference in Chicago of officials administering engineers' licensing laws and the one in St. Louis of those administering architects' laws show that the officials appreciate the need of uniformity. Now that the principle of licensing is accepted, it is the part of wisdom to do all in our power to render the laws most effective and their administration most efficient.

Spending Highway Dollars

LIKE all other activities, highway work is recovering from the war's unsettlements. In the era of easy money huge expenditures were freely planned. The people were free with their own money and placed the public's money freely at the disposal of officials. A reversion has set in. The private dollar and the public dollar are being more carefully scrutinized. Retrenchment, or at least circumspection, in public expenditures is the order of the day.

The results are seen in the thinking of highway engineers the country over. That has been clearly brought out in the series of articles on "The Trend of Highway Development," published recently in this journal. The trend in many sections is distinctly in the direction of using a cheaper type of surface, under efficient maintenance, instead of the expensive permanent types so universally popular only two years ago. In the Middle West the art of gravel-road construction and maintenance is being given careful study—with gratifying results. In Illinois, the practice of letting work and more work, despite hold-over contracts, has given way to a policy of finishing first that which is under way. In the New England States, with their long and careful highway experience, economic problems are to the fore. Is it just, they ask, that a small percentage of very heavy vehicles should force upon the community extraordinarily high construction and maintenance costs?

To commend the soundness of the changed point of view is unnecessary. It was bound to come with freedom from the war's turmoil and its muddled 1919 aftermath.

Highway Research

NOTABLE among the highway developments of the year is the impetus given to scientific research. The Bureau of Public Roads continued its studies of impact loads and of methods of reducing the water content of subgrades. The Pennsylvania highway department began laboratory studies of cores cut from pavements in service and will take the opportunity offered by the removal of these cores to study the action of subgrade. A test road of several sections of different construction has been built in Illinois and a series of subgrade and surface investigations has been undertaken. Other states are making observations on the capillarity and the compacting of soils and on methods of soil treatment to reduce moisture troubles. The engineering division of the National Research Council in November created an advisory board on highway research.

Surely the unsolved problems in highway work are so many that a wide program of research was badly needed. It is fortunate, too, that the subject has elicited the interest of engineers in so many parts of the country. Experimentation is needed under a great variety of conditions and by many experimenters, to the end that the conclusions may be generally applicable and that all of the original thinking available in the various highway departments may be brought to bear on the task. Scattered experimentation will all serve the common end if there be co-ordination in program and in the study and interpretation of results. To secure that co-ordination is the work of the committee of the research council.

A Municipal Dilemma

MUNICIPAL governments and taxpayers at the present moment face a dilemma. Further postponement of water-works, sewers, paving, bridge and other construction now long in arrears seems suicidal, but the labor, material and capital markets are still unfavorable, and, worse yet, uncertain. The taxpayer blows hot for city improvements and cold against the increasing tax burden.

Under such conditions what shall the city authorities do? There is only one safe course: Every municipal improvement must be considered first on its own merits, then in relation to the merits of all other municipal needs. When this has been done a program must be adopted—a construction program for several years, carefully adjusted to the relative urgency of various improvements, to the financial condition of the city and to the reaction of the proposed outlays on the taxpayers and on the credit of the city.

The financial burden of city improvements can often be reduced by seeing that it is properly distributed among those directly or chiefly benefitted. This applies particularly to (1) all those public works that may properly be paid for by assessments for benefits, and (2) to revenue-producing utilities. Besides being just, such a distribution of cost tends to moderation and discrimination in the popular demand for improvements.

The determination of the actual and relative need for various city expenditures, the formulation of a corresponding program and the allocation of costs, are all problems that demand careful engineering study.

Garbage Disposal Uncertainties

GARBAGE disposal is a municipal activity that at the minute involves more than the usual number of difficulties. There are so many uncertainties that beset costs and revenues that cities having to make a choice of methods should take unusual care. That capital seems bound to remain high is about the only certainty. What will happen as regards labor, materials and supplies is a matter of conjecture, as is also whether the recent slump in the prices of grease, tankage and live hogs will be permanent.

Until conditions become more settled there is strong reason for choosing that method of garbage disposal, where the choice is open, that involves least capital, labor and material, and at the same time will produce some revenue to help reduce the cost of disposal and can most readily be abandoned in favor of some other and better method if one is offered. Taking this into consideration there is much to be said for garbage disposal by feeding during the next few years. The installation and operation of incinerators or destructors requires much capital and yields no revenue. Reduction means still larger capital, labor and material requirements with uncertain revenue for the immediate future, besides the possibility of the loss of the entire capital investment. Feeding to hogs requires a relatively small capital investment and operating expenses that are also relatively light as compared with reduction and, very much in its favor, the principal capital investment required for hog feeding is liquid in character since the hogs can always be converted into cash, and they form the bulk of the capital investment.

Finally, in these unsettled times, there is more need than ever that cities large and small should be guided by competent engineers in everything pertaining to the choice, design, construction *and operation* of garbage disposal works, including collection, transportation and final disposal.

The Water-Power Act

ONE of the distinct engineering accomplishments of the year just closed was the passage of the water-power act. For fully eight years water-power legislation had been the subject of strife in each succeeding Congress. When finally the conservationists, who proved in effect to be actual obstructionists of water-power development, were satisfied with the measure it died in 1919 through failure to bring it to a vote in the Senate. At last the measure has gone through with the approval of all parties.

Applications for permits or licenses for development under the act have been made at the rate of about one a day since the Water-Power Commission was organized, which means that 134 projects had been entered up to Dec. 25 for more than 12,000,000 hp. This development would cost well over a billion dollars and represents 40 per cent more power than the estimated water-wheel production of the country today. So far as *intentions* go, then, the new federal water-power policy has proved successful. *In actual construction* nothing whatsoever has resulted; in fact, no license or permit under the act has yet been issued nor is there much prospect of many being issued until the commission is given the money, for which it is now asking Congress, to make the investigations and surveys required under the law.

The number and distribution of the applications, however, indicate a lively interest in hydro-electric development. Undoubtedly many of the proposed projects are merely promoters' dreams and others—such, for instance, as the much advertised 3,000,000-hp. development of the Colorado River above the Grand Canyon—are far ahead of any present intentions, but most of them must represent honest prospects which will proceed just as fast as money can be obtained. The state of the money market is the main retarding influence in water power today and it operates nearly as actively under the present water-power act as it would under the old restricted government regulation. Not until money eases up will the real test of the new act come. Meanwhile several amendments of the act are before Congress. Most of them are of a routine nature and of little importance except that if passed in proper form they may serve to remove the doubts cast on the act's validity by the peculiar circumstances of its signing. The irregularity of this signing has been consistently ignored by most of those connected with the law, but there are some who fear injunction or other delaying tactics at a critical time in the prosecution of a project under the law and would prefer to see all doubts as to its validity removed.

It was freely predicted during the campaign for the act that the rush to build power plants would be immediate. Conditions beyond the scope of the act have served to retard any such rush, but the prospects for development as indicated in the applications seem to show that the work will be undertaken when conditions are ripe. Actual permits and work started will be better evidence than promises to start, but the multitude of applications and the amount of power involved in them augur well for future extensions.

Financial Situation of the Railroads and Its Effect on Improvment Policies

Returns From New Rates Thus Far Justify Only Such Improvements as Are Necessary to Put More Traffic Over Existing Tracks

By T. De Witt Cuyler
Chairman, Association of Railway Executives

IN A country growing like the United States and with such great possibilities the job of building up railroads, to keep pace with the development of the country's business will never be ended in our time. "Man never is, but always to be blest."

The decision of the people of the United States in favor of legislation establishing private ownership and government control, though the Transportation Act of 1920, has been adopted for these reasons:

1. To assure to the public adequate railroad service and to preserve in railroad management and work that spirit of individual enterprise, economical administration and competitive emulation in good service which is lacking in governmental work.

2. To establish rates which will not only be fair to the public but establish and preserve the credit of the railroads so as to insure their extension in localities where new lines are needed and the expansion of equipment and facilities where railroads are already established, so that the needs of the entire nation may always be met.

3. Last, but not least, to maintain skilled personnel and to maintain a high morale in a system which preserves American traditions and one which has given to America, notwithstanding the experiences of the war and the resulting increase of rates, a railroad service cheaper and better than any other in the world.

Returns From New Rates

The new rates, made effective by the Interstate Commerce Commission Aug. 26, had as a major objective the establishment of railroad credit. These rates were based, necessarily, upon a volume of traffic determined by estimate. This volume, however, may or may not be actually developed by the business of the country. The roads have no guaranty of earnings under the act.

The ability of the railroads to engage in any expansion program of large dimensions is dependent upon two things:

1. The actual achievement of a 6-per cent earning power as contemplated by the Transportation Act, and

2. A world-wide readjustment of the conditions of money and credit which would give an industry with a 6-per cent earning power the necessary standing in the investment market to command large funds.

We have at this writing only two months' complete returns of earnings under the present rates. But those for October, which was the biggest traffic month in the history of the country, indicated that the carriers were still over $20,500,000 a month away from a 6-per cent earning power. The October figures showed earnings of 4.9 per cent on the $18,900,000,000, which is the tentative property valuation of the Interstate Commerce Commission for rate-making purposes. At present there is a seasonal falling off in traffic.

As the carriers would be loath to attempt to make up this deficiency in net income by asking for a further increase in rates, the attainment of the 6-per cent earning power will be dependent on the ability of the roads during the coming year to make still further substantial economies and increases in efficiency.

The capital expenditures programs of the railroads for 1920 and, so far as one can see, for 1921, *have been, and will of necessity be, programs directed mainly at removing situations which prevent the existing railroad lines from carrying maximum traffic over the existing trackage.*

Steady development for many years in heavy-power locomotives has left the country considerably deficient in adequate engine, roundhouse and repair facilities, and has cramped many freight yards and made many existing sidings inadequate.

In general, therefore, the expansion of these facilities—lengthening of sidings, new sidings, automatic signals, better train dispatching facilities, the further application of superheaters, and other devices increasing or economizing power, and the elimination of or widening of limiting tunnels, reducing grades, flattening curves, reinforcing rail, ballast, trestles and bridges for the use of heavier power, constitute the main items of work now being carried forward and to be carried forward during the coming year.

Lack of adequate terminal capacity is recognized as one of the most important aspects in which the railroads are not in advance, if even abreast, of the development of the country. A number of important improvements in terminal capacity are now in process of construction, notably the grain elevator of the Pennsylvania at Baltimore and the coal pier of the Western Maryland at the same city.

Other important projects on foot are:

1. The application of heavier power to the Chesapeake & Ohio Railway Co.

2. The building of a double track on the ruling grade of the Virginian which will almost double its coal-carrying capacity.

3. Three big freight yards on the New York, New Haven & Hartford.

4. The elimination of a limiting tunnel on the Delaware & Hudson.

5. The extension of the Louisville & Jefferson bridge.

6. The building of a cut-off on the Kanawha & Michigan.

7. Shortening curves and reducing grades on the Norfolk Southern.

8. The enlargement of yard and engine facilities on the Texas & Pacific and the Wheeling & Lake Erie.

All told, it is estimated that the carriers are expending some $250,000,000 upon such improvements, of which about $70,000,000 is being financed by loans from the fund provided by the Transportation Act and most of the remainder out of earnings.

The railroad companies have ordered approximately 50,000 freight cars this year. Of these, some 15,000 will be refrigerator cars, there having been no net additions to this class of equipment for some years, and there having been no refrigerator cars constructed at all during the entire twenty-six months of federal control.

The companies either have ordered or are making the financial arrangements to purchase approximately 1,500 additional locomotives and about 1,200 passenger cars. The total cost of this equipment is approximately as follows:

45,000 Freight cars	@	$ 3,000 each	$135,000,000
15,000 Refrigerator cars	@	4,500 each	67,500,000
1,500 Locomotives	@	70,000 each	105,000,000
1,200 Passenger train cars	@	35,000 each	42,000,000
Total			$349,500,000

In addition to this, the Pullman Co. is building 500 Pullman cars this year, none having been built during the period of federal control.

In addition some rather extensive development of railroad piers is in contemplation in the harbor territory of New York City, but whether or not this can be carried forward until the railroads are really earning a 6-per cent return and on that basis are able to attract large investment of new capital is a question which cannot at this time be confidently answered.

With regard to equipment—its present high cost will probably put a premium upon the reconstruction of old equipment to an unusual extent, while the higher efficiency with which the companies recently have been able to use cars and locomotives will probably reduce the amount of new equipment which they feel justified in purchasing at present prices.

Economy Necessary

The economy of the carriers in making only minimum expansions in equipment and facilities at the present time is ultimately to the interest of the public as well as the railroads, as it will prevent getting into the property value of the railroads (on which the rates of the future must be based) a relatively large amount of property at the present excessive prices.

With readjustment of investment conditions, and ampler earnings, the railroads will undoubtedly proceed with more confidence, but until then sound policy on their part was well expressed by Interstate Commissioner Aitchison in his speech in Washington on Nov. 10, when he said:

"The present financial situation coupled with the apparent downward trend of construction costs makes it seem prudent not to engage upon any undue or avoidable construction program until conditions become more normal . . ."

While a great deal has already been done by the carriers the following general considerations should be taken into account:

1. The railroads could certainly not be expected to expend the money until they receive it, but it can hardly be claimed that the railroads are in actual receipt of any great benefit as yet, nor could they possibly have already expended any large amounts from recently increased rates.

2. The transportation Act provides for the next two years that rates shall be fixed by the Interstate Commerce Commission which will provide net earnings equal to 5½ per cent of the value of the property. This, generally speaking, was for the purpose of a return to the investor and an improvement in credit, and an additional ½ per cent of such property value to make provision in whole or in part, for improvements, betterments, or equipment. From the figures so far obtainable, few railroads have realized from the increased rates and fares a return of 5½ per cent, much less one-half of one per cent to be devoted to betterments.

3. Taking the matter of equipment—a permanent investment at the present high costs and high rates of interest involves a continued high charge to provide the necessary return. Expressing the idea in other words, a box car bought now for $3,300 on 8 per cent money would require an earning of $264 for interest alone, and would require much higher rates of freight to make such a return, than for the same car bought for $2,500 at 5 per cent money, for which the interest charge would be $125 per year.

I do not mean to contend that the matter of prices is more important than service, but it should be made clear that economy is unavoidable, as the credit foundation for large expenditures at present prices has not yet been established. The policy of the carriers, therefore, will have to be for a time, to some extent, to feel their way.

At the same time the more efficient use of present facilities, the betterment of their maintenance the reconstruction of old equipment, and the steady, even though small, acquisition of new equipment, will assure at least a considerable and steady improvemen in service.

While with regard to the provision of new facilities and additional equipment for 1920 the results are not as great as the railroad companies would have desired and as they expect them to be, I feel that the carriers so far have fully met their responsibilities in this difficult period of national adjustment.

The year 1920 has been the record year of American railroad operation. Not only has a larger gross tonnage been moved than ever before, but new records have been established in the amount of transportation gotten out of each car. Even during the war year of 1918 the highest performance was 494 ton-miles per car per day, while for August, 1920, the average was 557, and for September and October, 565.

Results Since March 1

In the nine full months since the government turned back the railroads to their owners on March 1, the railroad companies under private operation have:

1. Increased the average movement per freight car per day 6.3 miles—from 22.3 to 28.6 miles.

2. Increased the average load per car 1.7 tons—from 28.3 to 30 tons.

3. Made substantial reduction in the number of unserviceable locomotives.

4. Reduced the accumulation of loaded but unmoved freight cars from 103,237 on March 1, to 21,991 on Dec. 3, of which only 6,386 were detained because of the inability of the railroads to move them.

5. Relocated approximately 180,000 box cars from the East to the West for the movement of farm produce.

6. Relocated approximately 180,000 open-top cars from the West to the East to keep up the production of coal.

7. Moved the third highest coal production in the history of the country.

8. Spent over $500,000,000 extra on improving

the maintenance of tracks, bridges, cars and locomotives.

9. Contracted to spend about $250,000,000, largely out of earnings, for additions and betterments to promote the movement of cars.

10. Made arrangements to purchase approximately 50,000 new freight cars, 150 new locomotives, and 1,000 new passenger cars.

11. Begun the reconstruction of thousands of old cars.

12. Moved—with a deteriorated plant, under disturbed labor and business conditions—the largest volume of traffic ever known in a single year, with the highest efficiency yet achieved, and with a minimum addition to the value of the property on which the public has to pay a return through rates.

With this record for 1920, despite its adverse conditions, I see no ground for pessimism as to the future of private operation of the railroads.

Existing Water-Works Conditions and Needed Planning

Postponement of Betterments Because of War and Post-War Conditions Have Resulted in Widespread Inadequacy of Service

By George W. Fuller
Consulting Engineer, New York City

WATER-WORKS in many American cities were operated under severe stress during the war. High prices of labor and materials, restricted transportation facilities for all materials and supplies, reductions in net operating revenues, and inability to sell securities or to obtain necessary legislation, have prevented normal extensions and betterments for about five years. Depleted operating personnel, deferred maintenance to an abnormal degree, and increased water consumption due to war industries and to lack of vigilance in restricting waste and needless use, have been factors contributing to present predicaments. As a result the margin between peak demands of water consumption and the capacity of supply works is rapidly becoming inadequate in many cities. In some the margin is deplorably small because it will be difficult to supply the needs of the growing communities during the period necessary for financing, designing and building necessary extensions and betterments.

In large cities these conditions are ordinarily of more significance than in small cities because longer periods are required to provide remedial measures. Industrial cities, where manufacturers use the city water supply, are more involved than those communities which are not required to furnish much water for the industries, or where the more sizeable establishments can get water supplies of their own. This aspect is of practical importance because no community will intentionally restrict its future industrial growth on account of inadequate water supply facilities.

Postponements of betterments have occurred in all types of plants, both municipally and privately owned. But some of the latter are in a more serious condition than those of the former class. Decreases in their net earnings and uncertainties as to future income have made it impossible for them to finance new works, and the outlook in some instances is very precarious both for the plant owners and those desiring service from them.

The present inadequacy of water service involves both quantity and quality of supply. The danger stage for many water plants is being approached in one or the other of these aspects, or both.

Before the war water-works extensions and betterments on a sizeable scale were under consideration or execution at San Francisco, Winnipeg, Toronto, Montreal, Providence, Hartford, New York, Wilmington, Washington, Richmond, St. Louis, St. Paul, Detroit, Cleveland and numerous smaller cities. The projects were at various stages of inception or completion. Some went forward but others were halted by the war where that was permissible or necessary. Stringent need caused Winnipeg to complete its new supply during the war period.

Since the armistice reports have been made or other steps taken as to water supply betterments at San Francisco, the Oakland district, Kansas City, St. Paul, Milwaukee, Chicago, Detroit, Grand Rapids, Saginaw, Cleveland, Buffalo, Columbus, Memphis, Nashville, Knoxville, Atlanta, Baltimore, Wilmington and Philadelphia. Other cities are considering the matter and are endeavoring to get betterments under way.

The metropolitan district of northern New Jersey is facing a deplorable lack of water-works facilities, notwithstanding the fact that the Wanaque reservoir has recently been put under contract by the city of Newark. In portions of this district the general situation is distressing because the margin in capacity of supply works is insufficient to provide safely for local needs during the period required for financing and installing new supply works. The problem is still further complicated by some of the works being owned by private companies which are apparently unable to finance extensions, or to make satisfactory arrangements for the sale of their properties to the municipalities, or to effect negotiable programs for joint undertakings where the municipalities would build new supply works for delivering water to the local distribution systems. Such conditions usually spell delay and disaster unless practical co-operative programs are developed in fairness to all concerned. In this connection our thoughts revert to the successful program started some twenty-five years ago by the Massachusetts Metropolitan Water Board for the benefit of Boston and its suburbs.

Inadequate Recognition

The foregoing illustrations as to localities, where water-works conditions demand prompt and efficient attention, are obviously far from complete. It is known that a great many small cities and towns, particularly in the West, have had recent difficulty in getting water. Some towns in Kansas are so deficient in their water supply at times that they are obliged to ship in water by tank cars for domestic consumers. Even in the face of careful investigations some cities are finding it hard to formulate a program for providing an adequate water supply within their financial reach.

Small towns can be more quickly provided, from an engineering standpoint, with new works than large cities. But financially and as to the readiness with which public opinion can be crystallized behind a definite project, it is frequently the case that difficulties are relatively greater and perhaps more bothersome for small than for large communities.

During the past five years high costs and other obstacles to making replacements and building new works have caused a general postponement of water-works improvements. The resulting conditions as to water-works facilities are approaching the danger state to an extent far greater than has been generally recognized either by officials or by the public. When the line of demarcation between adequate and inadequate service is once passed it is frequently most difficult to recross it again, both as to time and money.

Warning Necessary

For the safety of the public a warning must be sounded urging that shortcomings in water supply facilities be investigated and placed clearly on record in various communities, where present or prospective deficiencies exist. Engineers have a service to perform during this reconstruction period in the formulation of sound public policy in this field. Collectively they should be more capable than any other group of men in getting the essential facts appreciated by local officials, civic organizations and the general public. But to attain this end they must forego their tendency to dilute their findings with needless technical details.

Reports should be based not only on sound engineering data and principles but they must be adjusted to a feasible financial and legislative program.

During the war and the later period of rising prices and of other handicaps to construction work there were reasons why many communities allowed their water situation to carry on as best it could. With the present period of falling prices and of unemployed labor it is inexcusable for officials to neglect this subject any longer.

One of the most important steps to be taken at the outset in viewing a water-works undertaking is to see that a well considered program of operating economies and efficiencies is put into practical effect. In particular does this relate to curtailing needless waste.

In many communities it is far cheaper and quicker to save a million gallons of water now being wasted than it is to install facilities to increase the capacity of the existing works by such a volume. Since the armistice progress has not been rapid in many places in restoring operating conditions to a pre-war basis and there is much that can and should be done to conserve present facilities.

Far-Visioned Planning Needed

One of the great difficulties with American water-works has been that too frequently they have been built piecemeal, in conformity with the views of the particular personnel in charge at the time, and without reference to either past or future programs for connected procedure. At Boston, New York, Cincinnati, New Orleans and some other places well-conceived plans for a long term of years have been prepared and new construction adjusted to such a program.

As a part of effective city planning such undertakings are essential and well worth their cost. There are many cities in the country today that will do well to set about at once to make the most they can of their present water-works facilities and at the same time to lay out a definite, general program for future water requirements which should be specifically adopted and carried into execution regardless of changes in local administrative bodies.

The Water Supply of Barranquilla, Columbia, South America

Intermittent Operation Permits Draining of System —Fuel Is Wood and Getting Scarcer— Filter Plant Projected

By George C. Bunker
Sanitary Engineer, Balboa Heights, C. Z.

UNTIL recently the raw turbid Magdalena River water was delivered unsterilized to the citizens of Barranquilla, but a chlorination plant now protects the user and plans have been made for a purification plant. Three steam pumps located in a station on the Magdalena River opposite the center of the city distributes the water directly to the consumer, the excess flowing into a 900,000-gal. reservoir.

The pumps are operated only 10 to 12 hours daily starting between 1:00 and 3:00 a.m. This system of intermittent pumping calls for the installation of individual service tanks of sufficient size to hold a supply to cover the demands during the non-pumping periods. When the pumps are shut down the valve on the discharge line from the reservoir is closed to hold

FILLING STATION FOR WATER PEDDLERS

the water in reserve for fire protection, and a large part of the distribution system is therefore drained during the non-pumping period. As a large number of taps are always left open, a large amount of air must be expelled from the system when the pumps are started. Water hammers frequently open the joints and start many leaks.

Due to the non-development of coal mines and the oil fields and to the lack of transportation facilities, wood is used as a fuel throughout the city. It is cut on the watershed of the Magdalena River and brought to the pump station in small sail boats. The price has advanced from $2.50 per cord in the latter part of 1919, to $4.50 and $5 in the first half of 1920. Furthermore the deliveries are daily becoming more uncertain due to the gradual depletion of the forests bordering on the river. This condition is not surprising when one stops to consider that all of the industrial plants have used wood as fuel since their installation and that the river boats use the same fuel. It is predicted by the business men of the city that crude oil of the country will be available for fuel within a year.

No meters are in use on the 4,000 services, the charges being based on the size of the service pipes. For example the respective charges for ½-in. and ¾-in

services are $1.50 and $1.80 per month, with no restrictions on the amount of water used. Galvanized-iron pipe screwed directly into the cast-iron mains is used exclusively for services. The average life is four to six years. As is the case with many South American cities there are no fire hydrants.

The poor people on the outskirts of the city are supplied from public hydrants known as *pilas* from which casks or other containers are filled and the water is then peddled on burros. An employee of the water company is stationed at each hydrant to collect the charge of 2c. for each cask of a capacity of 3 gal. The same amount of water is retailed for 6 to 10 cents.

TINAJA (WATER JAR) UNDER AMERICAN-MADE HOUSEHOLD FILTER

The river water is muddy and of moderate hardness during the greater part of the year. During the extreme low stages in February and March the turbidity decreases to a minimum, but during the same period salt water from the ocean works back up the river past the intake. In some years a salty taste is noted.

Up to June, 1920, no method of purification was employed by the water company, but during that month a chlorinator was installed as a result of an investigation and recommendations made by the writer in the latter part of 1919. Preliminary plans, estimates of cost and a detailed report on the purification of the water supply have also been submitted by the author and are under consideration. It is probable that the first steps toward the construction of a purification plant will be taken during 1921.

Epidemics of dysentery have been frequent and the death rate of children has been excessively high, but contrary to what would be expected the death rate from typhoid fever has been comparatively low.

The better class of inhabitants use in their residences small American-made filters containing hollow cylinders of diatomaceous earth through which the water is forced by the pressure maintained in the distribution system. In office buildings and factories, filters of the same type but of a larger size are in use. These filters will easily remove a turbidity of 400 p.p.m. (not to be taken as a maximum), leaving the effluent clear and sparkling with a true color of 10 to 25 parts. Bacterial examinations of the effluents from several of these filters indicate that the bacteria were reduced to from 0 to 10 per c.c. from 4,000 per c.c. in the raw water, and that members of the B. coli group were absent in 50 c.c., provided that the stones were free from cracks and were carefully cleaned each day and that the gaskets were in good condition.

WATER JAR MARKET NEAR CANAL

It is customary to allow the effluent from the filter to drop into a large red-colored earthenware vessel, known as a *tinaja*, which will maintain the water at a temperature lower than that of the air due to the cooling produced by the evaporation of the moisture on the outside surface.

Prior to the introduction of this type of filter large blocks of porous stone were employed. These were hollowed out in order to hold a few gallons of water and were supported on a framework of wood at a suitable height above a *tinaja*. It is necessary periodically to clean these stones with a soft brush in order to remove the sediment which fills the pores and prevents the passage of water.

The majority of the poor people use the water as it comes from the river without attempting to purify it beyond allowing some of the mud to settle out in a *tinaja*. A few people add a certain species of cactus, which grows wild, in order to clarify the water in a manner similar to that resulting from the use of alum. Flaxseed is also used to a limited extent for the same purpose.

There are two bottling works which sell artifically carbonated waters, derived from wells drilled in the limestone formation. The waters are hard and the salt content is high, but it is advisable for travelers to drink them while stopping at the hotels.

Plastering Code to Be Written

In collaboration with various people in the plastering industry, the United States Bureau of Standards has undertaken to write a national plastering code which will contain specifications for all materials used in wall plaster, with directions for their use. The results of the work will eventually form the basis of a Bureau publication. It is intended to be in such shape that it may be adopted by the municipal and state legislative bodies in the preparation of building codes. To assist the bureau in the work there has been called together a conference of representatives of the Portland Cement Association, the National Brick Manufacturers Association, Hollow Tile Building Association, Associated Metal Lath Manufacturers, National Lumber Manufacturers Association, Gypsum Industries Association, National Lime Association, National Association of Sand and Gravel Producers, Contracting Plasterers International Association, Operative Plasterers and Cement Finishers International Association, Wood, Wire and Metal Lathers International Union, National Board of Fire Underwriters, United States Supervising Architects Office, and the American Institute of Architects.

Maximum Traffic Service the Highway Tendency of 1920

Pavement Construction Curtailed and Construction of Permanent Grade With Temporary Surfacing Greatly Increased

SERVICE to traffic was the dominant idea in highway improvement in 1920. This is indicated (1) by the tendency to spread construction expenditures over a large mileage of grading and gravel surfacing instead of confining them to a small mileage of highly improved road; (2) by a wide extension of patrol maintenance, and (3) by increased attention to traffic investigation and control.

Pavement Curtailed

Actually there were more miles of paved road constructed in 1920 than in any previous twelve months of road building, but only a fraction of the construction contemplated was undertaken and not more than half of the work undertaken was completed.

Curtailment was compulsory in most instances. There were not enough contractors to construct the mileage planned, but the greater obstacle was lack of railway transportation for materials and equipment. Again, because of the lack of materials and contractors, combined with high prices and wages, the prices asked for construction were felt to be more than the public could pay and planned programs were voluntarily curtailed. There was no lack of money for construction, but where this money had to come from the sale of bonds so great a discount, generally, had to be allowed that the charge per mile for financing paved roads was excessive. This was a final reason for curtailing their construction.

Supporting all these specific reasons for reducing paved road mileages, there was the general conviction, in many sections of the country, that money should not be expended on a small mileage of highly improved highway until traffic was well served by a large mileage of highway moderately improved by grading and temporary surfacing.

Permanent Grade Increased

There was, then, last year in all states having large mileages of unimproved main roads—despite curtailed paving operations—a large increase in highway construction. In many states this construction exceeded a thousand miles and in some states it approached two thousand miles completed to permanent grade and, in large part, gravel surfaced. This construction was possible because it could be conducted, largely, regardless of railway transportation. Local gravel pits supplied the surfacing, and the equipment required and the construction talent called for were of less special character than are necessary for paving operations and were, therefore, more generally available. This construction also was largely permanent. Wherever it prevailed as a definite improvement policy the old roads were built to final gradient and width and provided with permanent drainage; even the surfacing possessed a permanent value as a subbase for pavement when traffic demands this final improvement.

Quality production, prior to hard surfacing, of permanent grade and temporary surfacing was the construction policy particularly of those states having a large mileage of unimproved main roads. These states comprise most of the Mississippi Valley, the Far West and the South and parts of the East.

In states where main highway systems have been largely improved new construction has of necessity meant replacement with a more permanent structure or widening and strengthening the existing permanent surface. New York and Pennsylvania represent the extremes of policy. New York practically ceased construction except on work already in progress; Pennsylvania undertook new construction until, with the contracts brought forward from 1919, it had over a thousand miles of paved roads in progress. Briefly, New York values the needs of traffic at less, and Pennsylvania values them at more, than the market price of heavy-traffic paved road construction.

Maintenance Extended

Irrespective of construction policies, the extension of maintenance was universal. Wherever there was state control of construction, patrol maintenance was inaugurated or extended. With this extension there has come the new conception that maintenance is not merely the task of restoring and repairing highway structure, but is the business of facilitating travel by highway. Within this broader meaning are included all activities which increase the length of time when, and the safety and ease with which, *all the highways* may be traveled. Marking of routes, snow removal, planning detours and conducting repairs so as to block the road are all maintenance duties under the extended meaning.

Methods of patrol maintenance exhibit an improvement in the greater use of machinery, particularly of motor trucks and tractors, and in the selection of better qualified patrolmen. Truck and tractor patrol, by lengthening the section which can be traveled, have helped to meet the problem of labor shortage. They have, however, not demonstrated that they are materially cheaper than team patrol. The year's experience strengthens the conviction that it is the character and skill of the patrolman which determines the quality of maintenance, and these can be secured only by careful selection and by holding the men by adequate pay.

Snow removal and drift prevention are the outstanding development of 1920 in traffic maintenance. Practice in Pennsylvania exemplifies the best methods. It involves prevention of drifts by snow barriers, organization and equipment of patrolmen to remove snow, and prompt removal as fast as the depth reaches 6 in. In surface maintenance of gravel roads the year's experience demonstrates that success depends on continuous and persistent attention and not on special equipment.

Miscellaneous Developments

Traffic—Traffic has come to be considered the master problem in highway development. In 1920 the study of road failures from traffic demonstrated beyond question, if there were room for question before, the necessity of weight regulation of motor-truck traffic if present road structure is to have a reasonable life. The need of regulation was first experienced in the heavy-traffic manufacturing states of the East, but it has also appeared in the prairie road states of the West. Occasional heavy-truck travel, perhaps less than 1 per cent of the total truck traffic, accomplishes the damage. Opinion generally has settled upon legislation restricting weights as the most practicable remedy, and such

legislation has been drafted by a number of highway departments for consideration at coming sessions of state legislatures.

Consideration of traffic problems has, however, during the last year proceeded far beyond weight regulation of vehicles. It is perceived that the matter is of such importance as to demand a comprehensive and accurate study by every state. Opinion is coming to the agreement that without such studies there is no sound basis for highway legislation, appropriations, organization and design.

Design Tendencies—Thought on highway design in 1920 exhibited a radical departure toward design in detail. This is particularly true in reference to foundation design. Studies of soil physics have created a strong conviction that a road foundation must be a different structure for each character of subsoil. They have also indicated that with subsoils of high capillarity safety of design can be secured only by treating the natural soil to reduce capillarity or by replacing it with a more stable material. These conclusions from the study of soil physics are supported by service studies of paved roads in a number of states. In highway design in 1920 the notable development has been the preparation made by important road-building states to continue the study of soil physics and to observe the behavior in service of foundation soils of different character.

Construction Methods—No radical changes in methods of constructing paved roads occurred during 1920. The methods and equipment developed in 1919, as summarized in *Engineering News-Record*, Jan. 1, 1920, p. 8, have remained in use. There has been perfection in details. Except that methods which involve stock-piling on the subgrade are being generally discouraged and in some states prohibited, there is no evident approach to standard methods and equipment, nor has any method or type of plant demonstrated its superiority.

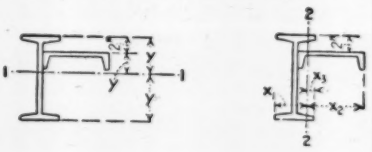
In grading practice the notable development has been the increased use of tractors in place of teams for operating grading equipment, and, in swamp locations, the use of dragline excavators and dredges for constructing fills. Tractor operation has been applied to elevating graders, heavy-blade graders and scarifiers and large-wheel scrapers in several Western States with very considerable advantage over team operation.

To sum up the highway tendencies of 1920: There is an effort to get for the public the maximum amount of traffic service with the funds available. This, the engineers are trying to accomplish by building more miles of less expensive surfacing, by maintaining roads adequately, by keeping them open in winter and by initiating studies and movements looking toward preventing a very small amount of traffic doing the greater part of the damage.

Properties of Crane Girder Sections

By John H. Sawkins
Schenectady, N. Y.

CRANE girders composed of a single I-beam stiffened by a horizontal channel attached close to the top flange are listed in the accompanying table. The



location of the gravity axis of the section is referenced both vertically and horizontally by three different dimensions in each direction, and the moments of inertia around the gravity axes are given.

This table, while it introduces no new ideas in design, should save time for the structural engineer and may frequently make it possible to select the right section more precisely than would be the case if the calculations must be made separately for each size of girder.

Attention is called to the fact that the full cross-section of the channel is included in the section effective to resist vertical bending.

PROPERTIES OF I-BEAM CRANE GIRDERS WITH LATERAL STIFFENING CHANNELS

	Section of Girder Depth and Weight Per Foot			Axis 1-1				Axis 2-2			
	I-Beam	Channel	Area	y_1	y_2	y_3	I	x_1	x_2	x_3	I
1	8x18	6x8	7.71	4.46	3.54	1.54	61.21	2.965	5.17	1.035	32.96
2	8x18	8x11½	8.68	4.547	3.453	1.453	62.35	3.595	6.54	0.405	71.20
3	9x21	6x8	8.69	5.04	3.96	1.96	92.38	3.03	5.28	1.30	35.26
4	9x21	9x13½	10.20	5.22	3.78	1.78	95.29	3.94	7.37	0.39	104.47
5	9x21	8x11½	9.66	5.16	3.84	1.84	94.25	3.60	6.71	0.73	75.06
6	10x25	6x8	9.75	5.60	4.40	2.40	133.84	3.085	5.40	1.575	37.80
7	10x25	8x11½	10.72	5.76	4.24	2.24	136.87	3.635	6.85	1.025	78.90
8	10x25	10x15	11.83	5.89	4.11	2.11	139.84	4.265	8.22	0.395	147.70
9	12x31½	8x11½	12.61	6.91	5.09	3.09	245.81	3.615	7.06	1.385	84.70
10	12x31½	10x15	13.72	7.09	4.91	2.91	251.96	4.175	8.50	0.825	156.75
11	12x31½	12x20½	15.29	7.31	4.69	2.69	259.35	4.945	9.73	0.055	276.50
12	15x42	8x11½	15.83	8.54	6.46	4.46	507.02	3.645	7.31	1.855	93.65
13	15x42	10x15	16.94	8.775	6.225	4.225	521.65	4.125	8.83	1.375	170.50
14	15x42	12x20½	18.51	9.07	5.93	3.93	539.30	4.775	10.18	0.725	299.10
15	15x42	15x33	22.38	9.58	5.42	3.42	572.10	6.135	11.82	0.635	654.00
16	18x55	8x11½	19.28	10.115	7.885	5.885	911.00	3.73	7.50	2.27	103.08
17	18x55	10x15	20.39	10.39	7.61	5.61	938.40	4.14	9.09	1.86	183.30
18	18x55	12x20½	21.96	10.73	7.27	5.27	972.90	4.70	10.53	1.30	319.20
19	18x55	15x33	25.83	11.38	6.62	4.62	1038.8	5.96	12.27	0.04	698.3
20	20x65	8x11½	22.43	11.10	8.90	6.90	1327.6	3.765	7.61	2.485	111.72
21	20x65	10x15	23.54	11.395	8.605	6.605	1367.4	4.115	9.26	2.135	194.17
22	20x65	12x20½	25.11	11.75	8.25	6.25	1417.5	4.625	10.75	1.625	334.90
23	20x65	15x33	28.98	12.46	7.54	5.54	1516.2	5.765	12.61	0.485	731.30
24	24x80	8x11½	26.67	13.18	10.82	8.82	2348.0	4.035	7.715	2.965	128.12
25	24x80	10x15	27.78	13.50	10.50	8.50	2417.0	4.34	9.41	2.66	212.85
26	24x80	12x20½	29.35	13.91	10.09	8.09	2506.3	4.78	10.97	2.22	358.05
27	24x80	15x33	33.32	14.75	9.25	7.25	2684.4	5.81	12.94	1.19	772.90

Protecting Buildings Against White Ants

Referring to the article on "Protecting Buildings from White Ants," in *Engineering News-Record*, June 3, 1920, p. 1110, a correspondent in India writes that Indian practice improves on the methods given in the article "in one small but effective particular. The ant-proof floor is carried without a joint over the whole plinth area of the building, covering the walls too, and the walls are then started afresh over this floor."

Business Conditions in Relation to Construction

Labor Well Along in Readjustment, and Unemployment Threatening To Become Serious—Materials Prices Have Only Recently Begun To Recede

THE close of 1920 finds all industry in the grip of the same giant swing downward that has followed each former period of great industrial and financial inflation. All phases of American industry, keyed to a super-pitch by war pressure, entered the year functioning at maximum capacity, and continued to produce both fabricated goods and raw materials in unprecedented quantities. World-wide crops of record-breaking size and European difficulties in financing importations combined to cut agricultural values to such an extent that the buying power of America, originating in the marketing of farm products, shrunk something like $6,000,000,000. The immediate result was to curtail sales of all commodities both in wholesale and retail markets, and thereby cause an overproduction and an accumulation of unmarketable stocks. Inevitably, production has been and is now being curtailed, such curtailment being evidenced by shorter hours of work, fewer shifts, reduced staffs and shutdowns throughout a wide range of activities. The construction industry is lagging in its progress along this troubled path of readjustment, in that deflation of prices has failed to keep pace with reduction in activity. Only in the last three weeks have appreciable price changes occurred in any building material line other than lumber and such reductions as are reported have the appearance of being tentative as they are not proportionate to price recessions in kindred commodities.

Wage Reductions Widespread

Labor being a large part of the cost of all construction, its present condition and future outlook is a prime consideration. The nation is today more nearly free from strikes and threatened strikes than at any time in five or more years. Labor councils are showing every evidence of a disposition to submit differences to arbitration and to accept wage reductions where such action is vital to continued operation. Reduced industrial operations have caused all sections of the country to report plentiful supplies of labor, particularly common labor, and in some localities unemployment has approached the proportions of a problem. In the Pacific Northwest, particularly hard hit by reason of reduced activity in the lumber industry, reports show over 10,000 men out of work in both Portland and Seattle. Tacoma and Seattle are taking steps to start certain public works which were to have been inaugurated in the spring, as it is necessary to provide work at once for the heads of distressed families, the number of whom is being augmented daily by the closing of additional logging camps, mills and factories. On this public work no wage adjustment from existing scales is contemplated. In private work, recessions are the rule, wage cuts ranging from 15 to 25 per cent being reported in many lines. San Francisco reports a threatened strike of public service employees averted, at least temporarily, and a plentiful supply of labor even in the construction field. A greater influx of Eastern skilled labor is reported from Southern California than is usual at this time of year and skilled workers are more easily obtained than formerly.

The copper-producing sections all report reduced wages, effective January first. In the Upper Peninsula of Michigan and in Minnesota reductions range from 12 to 22 per cent, averaging 17 per cent. Certain companies desiring to assist their employees to lighten living costs in the face of reduced incomes are selling coal to their men at $7 per ton regardless of its cost of $9 and have cut the rent on company-owned houses from $1.50 per room per month to $1 per room. Several thousand men have been laid off in this district, production being curtailed about 30 per cent. In Montana, where miners have been drawing $5.75 per shift, the new scale is established at $4.75. This is still $1.25 above the wage specified by the sliding-scale schedule. Cuts in Arizona are announced as being 80c. per shift in the smelters and $1 in the mines. Some talk has been heard, particularly in Arizona, regarding resistance being offered to the cuts, but it may be discounted as a shutdown would be clear profit to the operators.

The steel industry, under pressure of reduced demand, is reducing working forces instead of cutting wages. In the case of the independents this reduction approximates 50 per cent while the companies allied with the Corporation are operating with about 70 per cent of the force employed during the summer. The railroads have cut shop forces in all sections of the country and report ample supplies of labor to handle any demand that fluctuating traffic may put upon them. Wage cuts and reduced forces are broadcast in the lumber industry, reports from Wisconsin, Michigan, New England and the South being echoes of those from the Far Northwest. The average report throughout the country is of 50 per cent operations in all branches of lumber production and handling. The textile workers, so busy early in the year, are not only being deprived of jobs by the thousand but have been compelled to accept a 22½ per cent wage reduction in New England, 15 per cent in the Carolinas, and greater or less cuts throughout the country. The garment trade is similarly affected.

The building trades, more closely organized than the workers of most other lines, have in general held wages up to scale. Great numbers of skilled tradesmen are out of employment however, and signs are noted which look to a downward revision of present scales or a breaking down of closed-shop rule. From Atlanta and Minneapolis, widely separated geographically, come reports of similar nature—from Atlanta, a new scale with common labor 30c., carpenters 70c., plasterers and bricklayers 90c. and painters 60c. per hour, with casual laborers easily obtained at 25c. The Minneapolis scale is held intact, but numerous instances are noted of men cutting under the scale, even on union jobs. Here also skilled workmen are reported as taking jobs as common laborers. In Chicago, mill operators have asked the carpenters' organization to accept a reduction from $1.10 per hour to 85c., "to the end that plants and factories may be kept going and continued employment for employees be assured." The probable alternative is closing of the mills. In Chicago not more than 45 per cent of the building tradesmen are working at their trade

and the Illinois Free Employment Bureau reports 260 applications for work for every 100 jobs offered. No great unemployment problem is apparent, as here, as well as in certain New England cities, a reversal of the war-time migration of labor from the country to the city is in evidence.

In a survey of conditions in all sections of the country the most encouraging single feature is the almost universal willingness of labor to accept wage adjustments where forced by economic conditions and compatible with living costs.

Supply and Price of Materials

One by one, in the past twelve weeks, raw materials and commodities used in all industry have had the price peak established during the boom days of last spring sheared off. Building materials have offered at least as great resistance to the downward trend as any other class. In this line the first to succumb was lumber. The buyers' strike, now so universal, was first noted in a refusal of the prospective home builder to proceed with his plans. This, coupled with low export demand, beat lumber prices down in 10 and 15 per cent jumps until it is now bringing practically pre-war prices, when sold. The drop has averaged close to 45 per cent. The force of this movement has lately been arrested with the exception of its action on West Coast lumber, on which further recessions of from $1 to $3 per M. feet are noted in the closing days of December. Claims that lumber prices are now on the bottom seem substantiated by the fact that mill prices now are in many cases below cost of production. The future policy will apparently be to lower cost via the wage-cut route rather than to increase selling prices.

November and December saw the price of coke, an important factor in iron and steel production, cut in two, and lower steel and iron prices followed. The U. S. Steel Corporation's prices are unchanged, but the independents, formerly charging from 20 to 30 per cent more, have cut to the corporation scale, the last change to be announced being on bessemer-steel rails, which are now quoted at $47 per ton base by all interests. The Pennsylvania Railroad Co. closed orders for 200,000 tons at that figure during Christmas week. The corporation's report of unfilled orders has shown a decrease of 1,600,000 tons in the last two months and all companies are curtailing output, the average reduction being placed at around 30 per cent. Ample supplies of ore are on hand at the various plants and with coal available in any desired quantity, supply of steel products promises to be no problem in the coming season.

Coal has taken a real slump. The much-talked-of famine has, by a combination of 120,000,000 tons of production in ten weeks, reduction of industrial consumption amounting to probably 5,000,000 tons in the same period, warm fall and winter weather discouraging household consumption and a complete cessation of overseas buying, been turned into an over-supply. Operators state that the market is "saturated" and pit-mouth prices on bituminous grades have suffered reductions of nearly 50 per cent in the past three weeks. Ample supplies at reasonable prices are everywhere available and all materials in the production of which coal enters very largely will benefit by lowered costs.

Producers of other building materials have, in general, held fast to peak prices, but dealers are cutting in all directions, contenting themselves with lessened profits. In the New York district small cuts are recorded on cement, amounting to 20c. per barrel from producers and 30c. from jobbers. Plate glass, paints and roofing materials are also off from 10 to 20 per cent in the New York market, while brick is quoted firm at $22.70 per M. but is being shaded to as low as $21. New York prices should be helped toward readjustment by the resumption of free lighterage service by the railroads, which will cut the laid-down cost of all materials from $1 to $2 per ton.

Chicago, Minneapolis, Atlanta and Kansas City report widespread reductions in all classes of material from dealers, cast-iron pipe, roofing materials, paint, brick, gravel, cement, sheet metals and electrical supplies being variously mentioned. All cities reporting, which fail to report reductions in cement and aggregate, state that dealers expect cuts on these items soon.

Taken generally, material prices are unsatisfactory in that they lack stability. There is no uniformity, either in similar items in the same market or in any commodity in the various markets. When new coal, transportation and labor costs are firmly established and digested by the producing industry the much-needed stabilization will automatically come about and the intrinsic value of building materials will once more be a matter of common knowledge.

Slow Progress of Construction

The effect of the unstable markets in all lines has been to cancel or defer the greatest building program America ever considered. Without exception, all sections of the country report more construction contemplated than ever before. A billion dollars is available for road construction, and deferred projects in various localities aggregate another billion. Authorities in charge of public work show no disposition to go ahead on any development requiring great consumption of materials until prices have demonstrated some permanency. Private enterprise is held up, not only on account of uncertain prices but also because of the questionable future of industry which renders the future value of any structure problematical. As the liquidation movement approaches an end, both classes of work should show new life.

Nineteen-twenty totals of new work undertaken will exceed those of 1919, but the increase all occurred in the first six months of the year. Since July steady declines are noted, until now in the entire country only about one-third as much work as the 10-year average is in hand. California is fortunate in this connection, the activity common in other localities being maintained there until December. Los Angeles, in particular, has initiated more new work each month this year than in the same month in 1919.

From the remainder of the country reports are uniform. Seattle says "much big building construction awaits lower costs." Minneapolis reports "contracts, both public and private, are being deferred awaiting price and labor readjustments." New Orleans engineers have many finished plans on which unsatisfactory bids have been received and progress has been stopped for the time being. St. Louis is doing nothing but plan. Chicago lists $150,000,000 in deferred work. Cleveland and Cincinnati have extensive plans awaiting developments. New England, hard hit by the terrific slump in textiles, is just waiting. New York, with gigantic plans on the board, is letting but few con-

tracts. Atlanta, where wage and price cuts have already amounted to something, reports that much work is going ahead in January and February. A compilation of building permits from a score of cities scattered from the Atlantic to the Pacific shows November, 1920, figures 20 per cent less than the preceding month and 60 per cent less than in November, 1919.

Inability of rail facilities to handle the needs and product of American industry caused a large part of our troubles in the past year. In this connection it is worthy of note that the coal situation has so improved that, not only are the roads themselves assured of ample supplies, but the probable need of priorities to supply necessary industry with fuel is rendered remote. In common with other interests, the roads note material increases in the efficiency of labor, reflected in faster car movement, more rapid repairs and more economical operation. It is also stated that rolling stock, for two years depreciating in volume and efficiency, is now on the upward trend, the number of cars and locomotives being gradually augmented by both the addition of new equipment and the increased rapidity noted in effecting repairs. The policy of controlling authorities for the coming year, while not announced, is felt to be against the issuance of priorities in all cases except where really extreme necessity is shown. It is desired rather to permit the needs of industry to adjust the flow of facilities.

The Outlook

For once in our history reports of lowered wages, decreased output and falling prices seems to point direct to better business ahead. Our trading basis has been pitched too high for successful progress, and a shaking-down process was absolutely necessary. Decline of building permits all over the country and accumulation of deferred projects give proof of this. Wage reductions represent a return to solid basis. The fact that many wage adjustments are not so radical as might be justified, notably in the copper mines, shows that capital means to be fair, and the acceptance of the necessary reductions indicates the reasonable attitude of labor. Curtailed production proves producers to have ceased turning out finished product regardless of need or the lack thereof and will prevent clogging of markets with high-cost goods. Price cuts foretell a return of conditions under which it will be possible to proceed with construction with some assurance as to the future value of the finished project.

Engineers bid fair to be the favored individuals in the approaching industrial currents. The same conditions which seem to preclude the chance of any great volume of industrial work in the coming season point to the undertaking of a vast amount of public works and institutional enterprises. Never were so many municipalities considering water purification, sewage disposal and flood protection. Never were so many highway projects ready to start; never more school, college, bank, amusement and religious structures under consideration.

And for all these, money is available as soon as price stabilization is advanced sufficiently to satisfy the minds of the various officials in charge of government and institutional funds. Once more get wages and materials down to a point where a mile of hard-surfaced road can be built in the Middle West for $35,000, with proportionate costs elsewhere, and such work will start.

Financing Road Construction —A Banker's Viewpoint

By Howard F. Beebe
Harris, Forbes & Company, New York City

The remarks following are an elaboration of a paper read by Mr. Beebe recently before the American Institute of Consulting Engineers. They are of special interest because they bring out phases of the road building problem which engineers and many public officials do not always carefully consider. Mr. Beebe, in addition to his activities in his own banking house, speaks from an experience gained as vice-president of the Investment Bankers Association of America, and as former chairman of municipal securities, and legislative committees of that association.—Editor.

Modern road building is being done on such a comprehensive scale that the matter of financing it on the part of the states and their political subdivisions has become one of increasing interest and importance. The magnitude of highway work throughout the country made necessary to meet present-day traffic problems involves an outlay so large as to represent in many cases a large percentage of the total outstanding indebtedness of counties and municipalities. Whereas, in years gone by, counties having an indebtedness in excess of from 3 to 5 per cent of the assessed valuation of property for taxation were regarded as extravagant, in many recent cases issues of road bonds have been authorized to an amount in excess of 10 per cent of the taxable values. It, therefore, follows that such a debt should be assumed only after the most careful consideration, the end in view being to keep expenditures for road purposes within reasonable limits of the ability of the taxpayers to meet the debt without undue burden, and to lay out the roads so as to serve the best interests of the taxpayers as a whole. To all intents and purposes these roads, with proper maintenance, should be permanent improvements. With the smaller debts which prevailed in the past, investment bankers could handle and recommend securities without careful thought to the expenditure of the funds, because, even though they were wasted in part or in whole, the payment of the debt would not work a severe hardship upon the taxpayers. With the increase in the ratio of indebtedness to taxable property values, the problem has radically changed, and conservative bankers are requiring that proper provision should be made to see that the money is carefully and wisely spent; that provision is made for maintenance of the improvements when installed; and that the principal of the debt incurred in connection with the improvement is retired in full within the useful life of the improvement.

The various committees of the Investment Bankers Association of America have been working consistently for some years past to provide more comprehensive and scientific laws governing the issuance and payment of debt for road purposes. While there is necessarily quite a wide difference of opinion as to just what the proper limits are, there is a substantial agreement that the percentage of indebtedness to

property values should be modest, inasmuch as the improvement was one which was not "self-sustaining," in that it returned no definite revenue from its use, such as waterworks, electric light plants, etc.

Time Bonds Should Run

The principal has also been very generally accepted that public debt should be retired within the life of the improvement installed with the proceeds. Although there is difference of opinion as to how long a period road bonds should be made to run, due to the wide variations in the character of construction of the roads and the volume and type of traffic passing over them, it is generally recognized that 30 years should be the outside limit for the most permanent kind of road, while bankers are more inclined to recommend a limit of 20 years, with the further recommendation that where it is not unduly burdensome, it is better practice to pay the debt off within 15 years.

Officials and bankers have also been working together so that proper provision may be made for funds sufficient to maintain roads properly, and great progress has been made in this direction. It is but natural that for the lack of a practical and comprehensive system of road maintenance and a well thought out scheme of finance, there should have been created a very unfavorable impression in the states where large expenditures have been made for road improvements which have been allowed to go to rack and ruin within a comparatively short period of years. Inasmuch as modern road building on a more or less extended scale was first undertaken in the northeastern part of the country, the feeling that such work has been accompanied by extravagance and waste is more prevalent in New England and in this part of the country than it is in other sections.

The fact that the history of road making and road financing is so unsatisfactory in our own state of New York has made it difficult for the average citizen, even though he be fairly well posted, to realize what a change has come about in the last few years. I think we may confidently look forward to the future for radically different results.

Problem Widely Discussed

The financial officials of some of the large insurance companies are giving the matter careful thought and are discussing it with investment bankers so that the weight of their opinion is being added in a helpful way in convincing officials and legislators throughout the country that changes are very necessary.

When speaking of the useful life of a road it is interesting to note that the U. S. Department of Agriculture, through its Bureau of Public Roads, has collected data of the most valuable kind, and I feel that I have been able, through the study of information received from that source, to speak understandingly with the officials in the various parts of the country. I likewise have been able to disabuse my own mind of certain prejudices which I had due to what I learned from a number of isolated cases, and which upon a further study and knowledge of the subject had proved to be anything but typical. For instance, I had been strongly inclined to criticize bonds running for more than 10 years when the proceeds were to be used for gravel and similar types of road construction, whereas I have become convinced that where a strict and adequate system of road maintenance is provided for such roads can be counted upon, where traffic and other conditions are favorable, to have a much longer life of usefulness.

With all due regard to the interests and comfort of those using the pleasure automobile, I think we would all agree that unless a road can be justified by sound business reasons it should not be built. That comprehensvie schemes of road building have been embarked upon in some counties, particularly in the southeast and southwest, without due regard to the tax burdens which they imposed, I think anyone will agree who has had occasion to be in touch with the agitation for road improvements. I believe it to be to the interests of each of us to use his influence in discouraging inadvisable projects of this kind. Possibly, references to what has been happening in one or two sections will illustrate what I mean better than any generalizations:

Arkansas Example

In Arkansas a roadway was projected through a very prosperous farming section. The engineering estimates of the cost exceeded $60,000 per mile, while the best bid received for the work under specifications exceeded $70,000 per mile. The contemplated expenditure was a very large one to be levied on the special benefit assessment plan against adjacent property. The character of the construction and the tax burden contemplated seemed to be unreasonable, and it appears that one of the most important arguments in favor of it was the ability, by the expenditure of a large amount of money, to get a liberal share of Arkansas' quota of Federal aid. The same argument was used largely in one of the important counties in Florida where authorization was made for road bonds to an amount approximating 14 per cent of the entire assessed valuation of properties within the county. In this case the desire of certain property holders to have the improvement so that it would benefit their holdings of land, to enable them to sell it at a handsome profit, was evidently the chief factor in enlisting their advocacy of the proposed authorization.

While not desiring in any way to be listed among those opposed to federal aid for state and county road building, I do wish to voice the belief that it was unfortunate that the matter has been handled in such a way as to stimulate the expenditure for roads at a time when costs of labor and material were at their peak. Authorizations and expenditures for road improvement work throughout many states have admittedly been made at the most inopportune times in order to secure as large an allotment as possible of the Federal-aid funds, and I sincerely hope that any additional contribution by the Federal government in aid of good roads will be handled in a much more practical way.

I think we will all agree that if the various individuals and organizations who have the good-roads problem at heart could work in close harmony the effect would be much more beneficial to everyone concerned than if their efforts are exerted singly. I also believe it would be most unfortunate if some of even the smaller political subdivisions of the states are allowed to embark on a program of road improvements which brings disaster upon themselves, for its effect will be to deter the cause of good roads in far-removed localities.

In solving financial problems incident to road building I have no hesitation in pledging the helpful co-operation of the investment bankers working either through their association or individually.

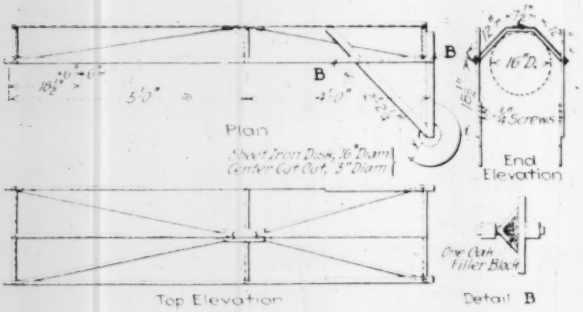
Velocity Tests in Hydraulic Dredge Pipe

Practicable Field Methods of Measurements Devised —Large Solids Lag Behind Main Stream— Kutter's *n* Determined

By Ivan E. Houk
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

VELOCITIES of flow in dredge pipes may readily be determined in the field by methods employed by the writer in tests conducted for the Miami Conservancy District. In these tests the velocity of clear water and also the velocity of single large stones, while pumping clear water, were measured. The methods employed are applicable in the field and give results which can be used to control dredge performance. The test data include velocities and friction slopes and values for Kutter's *n* and Chezy's *C*, which are useful.

The tests were made at different dates in the spring



APPARATUS FOR MEASURING VELOCITY OF DREDGE PIPE DISCHARGE

of 1919 in connection with the hydraulic fill operations at Taylorsville and Englewood. (*Engineering News-Record*, June 10, 1920, p. 1142.) Dredge pumps having 15-in. suction and discharge and direct-connected to induction motors with variable speed control, are in use at both places. At the time the tests were made two kinds of dredge pipe were in use in each line. One was a riveted pipe, made of comparatively soft steel, and the other, a hard steel, welded pipe, having a high carbon and manganese content. Both pipes had an internal diameter of 15 in., were made in lengths of about 16 ft. and were put together with stove-pipe joints. The pipe line conditions are described precisely in the foot notes to Tables I, II, and III.

Methods of Measurement—Rock velocities were obtained by simply noting the time required for the fragments to pass through the pipe, their passage being easily followed by the noise they made as they bounced along. The velocities of the water were measured by two methods, first, by noting the time required for potassium permanganate to pass through the pipe, and second, by noting the time required for salt to pass through. The former method needs no discussion since, having been frequently used, it is well known to engineers. Salt, however, has not been previously used in measuring velocities in pipes, so far as the writer is aware, although a very similar method has been used in measuring the flow of underground water.

The appearance of the salt at the discharge end of the pipe was determined by inserting in the jet two pieces of sheet metal, one zinc and the other copper, held about ¼ in. apart and connected to the terminals of a very sensitive voltmeter. The electrolytic action set up between the two poles as the salt water passed between caused a definite deflection of the voltmeter needle.

TABLE I. VELOCITY OF CLEAR WATER IN DREDGE PIPE AT ENGLEWOOD DAM, MAY 11, 1919

Motor Speed Step	Run No.	Velocity, Ft. per Sec.	Friction Slope, Ft. per 100 Ft.	Chezy's *C*	Kutter's *n*
	1	9 4	3 09	95 8	0 0124
	2	8 3	3 09	84 6	0 0136
	1	16 0	6 14	115 7	0 0108
	2	16 0	6 14	115 7	0 0108
	3	16 0	6 14	115 7	0 0108
	1	19 0	7 28	126 1	0 0106
	2	18 5	7 28	122 8	0 0101
	3	17 8	7 28	118 1	0 0106
	4	17 4	7 28	115 5	0 0107
	5	17 3	7 28	114 8	0 0108
	6	17 6	7 28	116 8	0 0106
Average value of Kutter's *n*					0 0110

NOTES.—Static lift, 30 ft. Area of cross section of pipe, 1.23 sq ft. Hydraulic radius of pipe, 0.312 ft. Length of delivery line, 780 ft., including one flap valve, two-15° bends, one long radius 90° bend, 60 ft. of standard wrought iron pipe with bolted screw flange joints, 20 lengths of riveted dredge pipe, and 26 lengths of welded dredge pipe. The alignment of the dredge pipe also contained some curvature made by a slight bending at the joints.

Both the salt and the potassium permanganate were inserted in the suction end of the line simultaneously, using about a pound of salt and about an ounce of potassium permanganate, wrapped together in a stout paper sack. The sack was attached to a stout cord and was lowered over the end of the suction pipe. When the sack entered the pipe the cord was jerked out of the observer's hand so that it was possible to determine accurately the time of entering the pipe. Of course, the paper sack was dashed to pieces by the high velocity in the pipe, or by the pump, if it held together until it reached the pump, so that the materials were well mixed with the water. The time of the arrival of the salt and permanganate at the discharge end of the pipe was noted by two observers, one watching the voltmeter and the other the color of the jet.

Different quantities of salt and permanganate and different methods of introducing them into the pipe had been tried before the date of the first experiments. Different materials for poles and different substances for the electrolyte had also been experimented with in the laboratory. The procedure described was found to be the most satisfactory.

The two methods were found to check very closely. While the permanganate method was entirely satisfactory for measuring the velocity of clear water, it could not be used when pumping material. The salt method was found to be satisfactory for either condition and was later used to some extent in determining the velocities and friction while pumping different materials.

A somewhat different method of measuring the velocity, similar to the one described by P. J. McAuliffe in *Engineering News-Record* of July 8, 1920, p. 62, was developed by Prof. S. M. Woodward, consulting engineer for the Miami Conservancy District, in August, 1918. It consisted, essentially, of an apparatus for measuring the curve of the center of gravity of the jet, as shown by the accompanying drawing. The two circular disks were a fixed distance below the center of the pipe and were centered over the jet by movig the apparatus along the pipe. One man moved the apparatus and noted the longitudinal distance of the center of the disks from the end of the pipe, while a second man, standing op-

posite the jet and on line with the two disks, watched the disks and directed the movement of the apparatus until it was in the proper position. This method was found to be entirely practicable and to be the best way

TABLE II. VELOCITY OF CLEAR WATER IN DREDGE PIPE AT TAYLORSVILLE DAM, MAY 25, 1919

Motor Speed Step	Run No.	Velocity, Ft. per Sec.	Friction Slope, Ft. per 100	Chezy's C	Kutter's n
1	1	7 70	1 16	128 0	0 0099
	2	7 66	61 13	129 0	0 0099
2	1	8 74	52 15	121 8	0 0104
	2	8 94	21 7	127 7	0 0100
3	1	9 94	14	121 6	0 0104
	2	10 2	2 09	126 5	0 0101
4	1	11 1	2 44	127 1	0 0100
	2	10 9	2 44	125 0	0 0102
5	1	11 4	2 61	126 5	0 0101
6	1	12 6	3 05	128 6	0 0099
	1	13 6	3 60	128 3	0 0099
7	2	13 4	3 67	125 2	0 0101
	1	14 8	4 10	130 5	0 0098
8	2	14 5	4 10	128 0	0 0100
9	1	15 8	4 61	131 8	0 0097
	2	15 4	4 49	130 3	0 0098
Average value of Kutter's n					0 0100

NOTES—Static lift, 13.5 ft. Length of delivery line, 1,340 ft., including one flap valve, one-30° bend, two-45° bends, two long radius 90° bends, eight joint of welded dredge pipe, and 76 joints of rivetted dredge pipe.

in which to determine the almost instantaneous variations in velocity which occur while pumping heavy loads of material.

Results Obtained—The results of the measurements are given in tables I to IV, inclusive. Tables I, II and III give the data on the velocity of the water and Table IV

TABLE III. VELOCITY OF CLEAR WATER IN DREDGE PIPE AT TAYLORSVILLE DAM, JUNE 24, 1919

Motor Speed Step	Run No.	Velocity Ft. per Sec.	Friction Slope Ft. per 100 Ft.	Chezy's C	Kutter's n
1	1	7 01	1 34	108 1	0 0114
	2	6 92	1 34	107 2	0 0115
2	1	8 04	1 72	109 5	0 0113
	2	8 10	1 74	110 1	0 0112
3	1	8 80	2 06	109 7	0 0112
	2	8 88	2 04	101 4	0 0111
4	1	9 33	2 33	109 5	0 0113
	2	3 93	2 33	116 4	0 0108
5	1	9 68	2 66	106 2	0 0116
	2	9 88	2 65	108 2	0 0114
6	1	10 9	2 89	114 8	0 0109
	2	10 9	2 92	114 2	0 0109
7	1	11 8	3 29	115 5	0 0108
	2	11 3	3 36	110 4	0 0112
8	1	12 7	3 78	116 6	0 0107
	2	12 7	3 67	118 5	0 0116
9	1	13 4	4 50	112 5	0 0110
	2	13 7	4 50	115 0	0 0108
Average value of Kutter's n					0 0111

NOTES—Static lift, 15.0 ft. Length of delivery line, 2,075 ft., including one flap valve, one-30° bend, four-45° bends, two long radius 90° bends, one-Y, 74 lengths of rivetted dredge pipe, and 56 lengths of welded pipe.

gives the data on the velocity of the rocks. The values of the Chezy coefficient and of Kutter's *n* are included in tables I to II. The friction slope was determined from readings of a carefully calibrated pressure gage, procured especially for test purposes, proper correction of course being made for static lift. The values of *n* are seen to vary from 0.0100 to 0.0136, in Table I, averaging 0.0110; from 0.0097 to 0.0104 in Table II, averaging 0.0100, and from 0.0106 to 0.0115 in Table III, averaging 0.0111.

In Table IV the weight of the rock, its velocity in feet per second, and its velocity in per cent of the velocity of the water, are given for each run. The averages of the latter quantity are also given for the different runs made with the same motor speed. It will be noticed that at Englewood the rock velocities varied from 77 to 100 per cent of the water velocities, the averages for the three motor speeds being 82.0, 95.8 and 93.5, respectively. At Taylorsville, where the velocities of the water were considerably lower than at Englewood, the corresponding averages varied from 78 to 86. This would indicate that the ratio of the velocity of the rock to the velocity of the water increases as the velocity of the water increases, which seems reasonable. At Englewood measurements were made of the velocities of the rocks from the suction entrance to the top of the toe of the dam, a distance of about 150 ft. on a slope of about 20 ft. in 100 ft., as well as of the velocities through the entire length of pipe. The velocities up this comparatively steep grade were practically the same as those through the entire length.

TABLE IV. VELOCITIES OF ROCKS IN DREDGE PIPE AT ENGLEWOOD DAM

Motor Speed Step	Weight of Rock, Pounds	Vel. of Rock, Ft. per Sec.	Vel. of Rock in per Cent of Water Velocity
	Test of May 11, 1919		
1s	4 5	7 2	77
	3 0	7 2*	87
	2 5	6 8	
Average			82
4	8 5	15 7	98
	5 5	15 8	99
	3 0	15 0	94
	1 0	14 8	92
Average			95 8
5	2 0	14 3	75
	8 0	17 4	94
	6 0	17 0	95
	5 0	15 7	90
	3 5	17 4	100
	5 5	17 8	100
	6 0	16 1	92
	4 0	16 2	93
	6 0	16 3	93
	7 0	15 5	99
	5 5	17 1	98
Average			93.5
	Test of May 25, 1919		
2	8 0	7 16	82
3	4 0	7 77	78
4	5 5	9 55	87
	3 5	9 29	84
Average			85.5
5	5 0	9 89	83
	5 0	10 1	89
Average			86
6	7 0	10.6	85
7	4 5	11 0	81
	4 0	11 8	89
Average			85
8	6 0	13 2	90
	13 5	11 9	82
Average			86

The tests described were made with the co-operation of the division engineers, O. N. Floyd and H. S. R. McCurdy, at the Taylorsville and Englewood dams, respectively, at times when the work would interfere least with the construction progress.

Mr. Arthur E. Morgan is chief engineer of the Miami Conservancy District, Mr. Charles H. Paul is the assistant chief engineer and Mr. C. H. Locher is the construction manager.

Engineers Demobilized in 1920

Approximately 60 Engineer organizations, a total of 94,000 men, were demobilized during the fiscal year ended June 30, 1920, according to the annual report of the Chief of Engineers.

Results of Tests for Distortion on Exterior Wall Sections

DISTORTION tests of frame-house-construction wall sections made by J. C. Peebles, testing engineer at the Armour Institute of Technology, indicate that a back-plastered Portland cement stucco on metal lath will produce the strongest wall. Four types of wall were tested. The specimens were 42 in. square, and all were framed with 2 x 4 studs held in an enclosing frame of the same material. For test, a section was set on its diagonal in a testing machine and loaded to failure. The results, as given in a report of Mr. Peebles to the Associated Metal Lath Manufacturers, are summarized below:

Back-Plastered Stucco on Metal Lath — No effect was noted until the load reached 10,000 lb., at which cracks appeared in both plaster and stucco near top and bottom corners of the sample. At a load of 14,200 lb. the sample was destroyed by the failure of the interior framework of 2 x 4-in. studs. The metal lath was torn from the studs, due to the failure of the latter, but the greater part of the plaster remained unbroken except for cracking and crushing around the edges.

BACK-PLASTERED SAMPLE TESTED TO DESTRUCTION MAINLY UNBROKEN

Siding and Sheathing—Plaster slightly crushed at top and bottom corners and a crack produced about 12 in. long near the top corner at a load of 5,460 lb. Sample destroyed by failure of interior framework at a load of 8,800 lb.

Stucco on Metal Lath Over Sheathing—Small cracks appeared in both plaster and stucco near top and bottom corners at a load of 9,100 lb. Sample destroyed by failure of interior framework at a load of 10,800 lb.

Stucco Over 6-In. Hollow Clay Tile — Tile, plaster and stucco crushed at top and bottom corners, and a crack about 15 in. long developed in the plaster just above the center of the sample at a load of 8,000 lb. Sample crushed so that tiles fell apart at a load of 9,600 lb.

The following is a description of the test specimens:

Back-Plastered Wall—Metal lath furred out by $\frac{3}{8}$-in. pencil rods on 2 x 4-in. wood studding with $1\frac{3}{8}$-in. Portland cement stucco on outside, back-plastered with $\frac{1}{2}$ in. of gypsum plaster. On the inside was $1\frac{1}{2}$ in. of gypsum plaster. Each wood stud was toe-nailed to the sill at the top and bottom with two 10d. nails.

Siding and Sheathing—Metal lath and gypsum plaster $1\frac{1}{2}$ in. thick on inside, and sheathing and drop siding $1\frac{1}{2}$ in. thick on outside. Each stud was toe-nailed to sill at top and bottom with two 10d. nails. Each piece of sheathing was nailed to each stud with two 10d. nails, and each piece of drop siding nailed with one 4d. nail.

Stucco on Metal Lath Over Sheathing.—Same as preceding except that in place of the drop siding $1\frac{3}{8}$ in. of Portland cement stucco on metal lath was used, furred out with $\frac{3}{8}$-in. pencil rods laid on ordinary building paper stretched over the siding.

Stucco Over 6-In. Hollow Clay Tile—Six-inch hollow clay tile covered on the outside with $\frac{7}{8}$ in. of Portland cement stucco and on the inside with $\frac{7}{8}$ in. of gypsum plaster.

Labor View of British Coal Settlement

TERMS of settlement of the controversy in the British coal-mining industry were commented upon in the *Engineering News-Record* of Nov. 25, page 1018. The industry, it was there noted, is put on a profit-sharing basis. A labor correspondent's view of the significance of the settlement appeared in a recent issue of the *Observer*, London. The following paragraphs from it will be of interest to American readers:

The profit-sharing introduced in the provisional arrangement is profit-sharing on a national basis. It assumes unified national control, the pooling of all the receipts of the industry, and the basing of advances on the results of the industry as a whole. It will be difficult for the National Wages Board, when it comes to base wages on profits after March 31, to go back on this principle, and to restore the district basis for wages which obtained before the war. Therefore the industry, unified by the Government for the purposes of the war, is likely to remain unified.

The miners secure the formal recognition of a principle for which they have been striving ever since the federation was formed, that wages shall be negotiated on a national basis. The main task of the new wages committee will be to consolidate the various cost of living bonuses, eliminate anomalies and systematize wages on a national basis. Before the war wages were on a district basis. If the seams of a field were poor, or the coal inaccessible wages were low. Today's wages could not be paid on half the coal fields of the country if they were not helped out by the richer fields. A national wage system will therefore rivet on the industry the unified control which the war instituted and national profit-sharing requires. But if the industry is to be unified public control will continue, for it is in the last degree improbable that any government will entrust a unified coal industry to a private trust.

Finally the district output committees which are to be set up are in effect an admission of the workers to a share in control. They go far beyond the Whitley report, since they allow the workers to interfere with the management of the pit, or at any rate to participate in the supervision of the management.

The miners, therefore, will secure by the settlement, if it goes through, not only the continued operation of the industry as a financial and industrial unity, but some participation in its control. It is just because their possible gains are so great that the task of the new National Wages Board will be highly controversial; and the public would do well to moderate their satisfaction until March 31 arrives, and the owners and men produce an agreed scheme for the permanent regulation of wages.

Engineering Legislation in Canada

An Outline of the History of the Movement for Statutory Control of Professional Practice, With a Synopsis of Acts Passed by the Provinces

By Fraser S. Keith
Secretary, The Engineering Institute of Canada, Montreal, P. Q.

The registration and licensing of engineers has been such a live issue in the United States during the past year that a recital of the progress of this same movement in Canada is particularly timely. "Engineering News-Record" feels fortunate in having induced Mr. Keith to tell its readers what the Dominion's engineers have accomplished in the control of professional practice. As Secretary of The Engineering Institute of Canada and in close touch with the legislative situation in all of the provinces, Mr. Keith is in a position to present the case comprehensively and authoritatively.—Editor.

LEGISLATION affecting the engineering profession in the Dominion of Canada, while an achievement of the past year, is in reality the result of many years of thought and effort on the part of the men interested in securing it. Attempts have been made from time to time to obtain the passing of acts limiting the practice of the profession. It was discovered in the initial attempts made, however, that the Dominion Government had no jurisdiction and that any legislation must be forthcoming, if at all, from the various provincial legislatures. An effort towards this end was made 25 years ago, which resulted in acts being passed in the province of Manitoba in 1896 and in the province of Quebec 20 years later. These, in the main, limited the practice of the profession to membership in the Canadian Society of Civil Engineers, the forerunner of the present national organization, The Engineering Institute of Canada. These acts, while continued on the statute books for many years, were found to be inoperative and in both cases were superseded during the past year.

In 1910 a petition was presented to the late premier, Sir Wilfrid Laurier, by the civil engineers in the employ of the Federal Government, enclosing copy of a proposed bill to organize and establish the engineering service of the Government of Canada. A change in government the following year resulted in the proposal being shelved. For a quarter of a century one of the stalwarts of the profession, C. E. W. Dodwell, of Halifax, at all times an ardent advocate of its interests, has endeavored to keep constantly before his fellow members his ideas of the benefit to be derived through legislation and no one man in Canada has been more responsible than he for what has recently taken place.

Activity Dates From 1918

The present activity might be truly said to have had its origin, development and fruition within the past 3 years, the year 1918 being one of discussion, 1919 of planning, and 1920 of achievement. During the past year acts regulating the practice of engineering have been passed in Quebec, Alberta, British Columbia, Manitoba, New Brunswick and Nova Scotia, while in Saskatchewan and Ontario it is planned to secure, if possible, similar legislation during the coming session from the respective legislative assemblies.

Although the subject had already been discussed at a number of the branches of the Institute, particularly in the west, it was introduced officially for the first time at a general meeting of the Institute at the second professional meeting at Saskatoon Aug. 10, 1918 by F. H. Peters, of Calgary, in a paper entitled "Legislation Concerning the Status of Engineers," in which the author expressed a firm belief that one of the surest methods of improving the status of the profession was by legislation, and this seemed to be in general the opinion of the western branches on the subject. At the same meeting a committee of the Saskatchewan branch presented a draft of a bill which it hoped to have approved by the council of the Institute for presentation to the local legislature. It proposed incorporating the membership of the Institute in Saskatchewan into the Engineering Institute of Saskatchewan. This draft was referred back to the branch with the suggestion that it be given further consideration. At that time there were members of the profession in Canada who considered that nothing would be gained from a policy advocating legislation, and others were openly opposed. The situation developed, however, until legislation has become an object of attainment in every province.

On Oct. 1, 1918, a special meeting of the council of The Engineering Institute of Canada was called to discuss legislation and consider the proposed act of the Saskatchewan branch. It was resolved at this meeting that inasmuch as other branches were considering the matter their ideas should be received before passing judgment on any single proposal. The same month the Vancouver branch at a general meeting passed resolutions endorsing legislation on certain broad lines, one of which was that any member of the profession qualified to practice in any province should be free to practice in any other province. It now became evident from the general interest in the subject, both east and west, that something should be done, and soon. The principle of securing legislation for engineers was endorsed by the council of the Institute and co-operation was promised the engineers of the various provinces in their efforts, it being laid down as fundamental that no legislation should be sought that did not include all qualified engineers, whether members of the Institute or otherwise, that legislation should be as uniform as possible and that it should include the right of an engineer registered in any province to practice in any other.

The following annual meeting of the Institute, held at Ottawa in February, 1919, saw such interest aroused in the subject that definite action was taken in a resolution passed calling for the formation of a special committee composed of one delegate appointed by each branch to meet at Montreal before April 15 to draw up such sample legislation as might be deemed necessary and advisable in order that uniform legislation might be asked for in the different provinces. The resolution further provided that the proposed legislation be sub-

mitted to the council of the Institute before May 1, to be followed by a letter ballot to the corporate members of the Institute before June 1 and, following a favorable vote, that the Council should co-operate with the branches to have such legislation enacted.

Following this resolution these representatives were appointed: A. E. Foreman, Victoria; A. G. Dalzell, Vancouver; F. H. Peters, Calgary; R. J. Gibb, Edmonton; H. R. Mackenzie, Regina; E. E. Brydone-Jack, Winnipeg; Newton L. Somers, Sault Ste. Marie; R. F. Uniacke, Ottawa; Willis Chipman, Toronto; Arthur Surveyer, Montreal; E. R. Gray, Hamilton; A. R. Decary, Quebec; C. C. Kirby, St. John; C. E. W. Dodwell, Halifax. This committee met at Montreal April 5, continuing its sessions until April 10, with C. E. W. Dodwell chairman and Arthur Surveyer secretary. The result of their deliberations was embodied in a proposed act in framing which they were guided by the following definite ideas:

(a) Before any legislative body can be reasonably expected to accept or to give serious consideration to any proposed bill it must be made apparent, not only to that legislative body but to the public, that the bill, as an enacted law, would redound, directly or indirectly, to the benefit of the community at large.

(b) It is eminently desirable that any such bill as may finally be decided upon shall be uniform for all provinces so far as reasonably possible.

(c) It is of the first importance that any such bill shall meet the views of and be acceptable to every individual engineer and to every engineering and technical organization in the country.

(d) It is indispensable, especially with a view to the future, that any such bill shall be as clear as language can make it and be also practicable and workable.

Main Features of Proposed Act

This act defines a professional engineer as any person registered under the provisions of the act. Its main features are summarized below:

The practice of a professional engineer within the meaning of this act embraces advising on, making measurements for, laying out and the design and supervision of the construction, enlargement, alteration, improvements or repairs of public or private utilities, railways, bridges, tunnels, highways, roads, canals, habors, harbor works, river improvements, lighthouses, wet docks, dredges, cranes, floating docks and other similar works, steam engines, turbines, pumps, internal combustion engines and other similar mechanical structures, airships and aëroplanes, electrical machinery and apparatus, chemical and metallurgical machinery and works for the development, transmission or application of power, mining operations and apparatus for carrying out such operations, municipal works, irrigation works, water-works, water purification plants, sewerage works, sewage disposal works, drainage works, incinerators, hydraulic works and all other engineering works. The execution as a contractor of work designed by a professional engineer, or the supervision of the construction of work as a foreman or superintendent or as an inspector, or as a roadmaster, track master, bridge or building master, or superintendent of maintenance shall not be deemed to be the practice of a professional engineer within the meaning of this act.

All persons registered as professional engineers under the provisions of the act shall constitute the Association of Professional Engineers of the Province of ..... and shall be a body politic and corporate with perpetual succession and common seal.

The association shall have power to acquire and hold real estate not producing at any time an annual income in excess of ten thousand dollars and alienate, mortgage, lease, or otherwise charge or dispose of such real estate or any part thereof as occasion may require. All fees, fines and penalties receivable and recoverable under this act shall belong to the association.

The association may pass by-laws for the government, discipline and honor of the members, the management of its property, the maintenance of the association by levying fees not in excess of five dollars per annum, the examination and admission of candidates to the study and practice of the profession and all other purposes reasonably necessary for the management of the association.

Who May Practice

(a) Only such persons who are members of the association hereby incorporated and registered as such under the provisions of this act, or who have received a license from the council of the association as hereafter provided shall be entitled within the province of ..... to take and use the title "professional engineer" or any abbreviation thereof, or to practice as a "professional engineer."

(b) Any person residing in the province of ..... at the date of the passing of this act, who is at that date and has been for five years previously practicing as a professional engineer shall be entitled to be duly registered as a member of the association without examination, provided that such person shall produce to the council within one year of the passing of this act satisfactory credentials of having practiced.

(c) Any person who may come to reside in the province of ..... and who at that time is a duly registered member of the Association of Engineers similarly constituted of any other province of the Dominion of Canada may become a duly registered member of the association without payment of fee for that year providing he shall produce to the council a certificate of membership in good standing in such province, and an application for transfer of registry endorsed by the registrar of the province in which he lately resided.

(d) Any person not otherwise qualified as hereinbefore mentioned residing in the province of ..... and who may desire to become a registered member of the association shall make application to the council, and shall submit to an examination, or shall submit credentials in lieu of examination, whichever the council may decide, and shall be admitted to registry as a member of the association on payment of prescribed fees after the council shall have certified in writing that such examination or credentials have been found satisfactory to it.

(e) Any person not residing in the province of ..... who is a registered member of an association of engineers similarly constituted of any other province of the Dominion of Canada shall obtain from the registrar a license to practice as a professional engineer in the province of ..... upon production of evidence of his registry in such other province and upon payment of a fee of one dollar. In the event of such person being unable by reason of emergency or neglect on the part of the registrar or for any other good and sufficient reason to obtain such license within three months of his making application thereof he shall be entitled to practice as a professional engineer in the province for such period of three months without holding such license.

(f) Any person who is not a resident of Canada but who is a member of any engineering or technical organization or society of standing recognized by the council may obtain a license to act in an advisory or consultative capacity to a registered member of the association.

(g) Any person who is employed as a professional engineer by a public service corporation, a private corporation, public utilities or government department whose business is normally carried on in two or more of the provinces of Canada, and who is by reason of his employment required to practice as a professional engineer in other provinces than that of his residence, may so practice in the province of ..... without holding a non-resident license or payment of fee, providing such person can on demand of the council produce credentials satisfactory to the council showing that he is a registered member of the Association of Engineers similarly constituted by some other province of Canada. It shall be the duty of such person to produce such credentials whenever so required by the council.

(h) Any professional engineer who is a resident of some other province of Canada in which there is no association of engineers similarly constituted may obtain a license to practice, subject to the discretion of the council.

(i) Assistants working under the direct supervision of a professional engineer and not taking responsibility for the work other than to their direct superiors shall not be deemed to be practicing as professional engineers when so engaged.

(j) The provisions of this act shall not apply against any person employed in the actual service in his Majesty's navel, military or aërial service.

(k) In the case of engineers who are practicing in the province of ....., and who have been accepted for overseas service in the present war in the forces of Great

Britain, or any of her allies, they shall on their return to Canada be entitled to all the rights and privileges conferred under subsection "b."

Administration—The administration is provided for by a council of management consisting of a president, vice-president and an optional number of councillors, the president and vice-president to hold office for one year and the councillors for two years.

Suspension—Provision is made for censuring, suspending or expelling from the association by the council any engineed guilty of unprofessional conduct, the method of doing so being embodied in the act.

Penalties—A penalty of a fine of not less than one hundred dollars and not more than two hundred dollars or imprisonment for not more than three months, or a fine of not less than two hundred nor more than five hundred dollars, or imprisonment for not more than six months for any subsequent offence is provided against any person who unlawfully practices as a professional engineer.

Examination—The council of the association has the power to nominate a board of examiners subject to such approval as the government of the province may require. A candidate failing on examination may after an interval of not less than one year be examined again.

Registration Without Examination—Application for registration or license shall be considered by council from any person who submits proof of qualification. The establishment of a central examining board is provided, to which the council may delegate powers to hold examination.

Age—The age limit for registration is 23 years. Any candidate must have been engaged for 8 years in some branch of engineering except in the case of a graduate from a recognized engineering college where the minimum requirement is 6 years, which may include his term of instruction.

Restrictions of Act—No provisions of the act restricting the practice of the profession or imposing any penalties shall take effect until one year after the passing of the act. The activities of the association are restricted to the functions necessary to the administration of the act.

The Quebec Act

The Quebec act differs from all others in Canada in that it is not a new act, having been on the statute books of the province since 1898 and is in the main a transfer of the operations of the act from the Canadian Society of Civil Engineers to the Corporation of Professional Engineers of Quebec, which consists of the corporate members of The Engineering Institute of Canada resident in the province of Quebec at the time of the passing of the act, which was Feb. 14, 1920. This act is more strict in its application than any of the others, being the former Quebec act under new administration. It provides for ipso facto membership in the corporation of all corporate members of the Institute in Quebec.

Inasmuch as it is planned to modify this act at the coming session of the legislature to conform to other provincial acts it need not be further discussed.

The Manitoba Act

The act incorporating the Association of Professional Engineers of Manitoba was passed March 27, 1920. Manitoba being the first province to adopt legislation based on what is known as the "Proposed Act" and which for the sake of brevity will be referred to as the "model." The association is governed by a president, vice-president and five councillors. It provides for a limit of $10,000 income but does not specifically limit the activities of the association to the functions necessary to the administration of the act. The age limit is 21. Candidates for admission shall serve under articles with a registered professional engineer 4 years unless a graduate of a recognized engineering college, in which case the term of service may include the term of instruction. Examinations are as in the model, subject to the approval of the Lieutenant-Governor-in-Council, there being provision for a central examining board. Reciprocity is included and registration of non-residents is as in model, except that newly resident non-members of other associations shall pay a fee. Exemptions are as in the proposed draft, the fee limited to $5 per annum. Penalties $200 or two months' imprisonment. Appeal for non-registration or suspension is heard before the King's Bench. All engineering work having a value of $1,000 or over must be done by professional engineers.

The Alberta Act

The bill incorporating the Association of Professional Engineers of the Province of Alberta became law April 10, 1920. The administration is as in the model except that councillors equally represent the various branches of engineering. A two-thirds majority is required to amend by-laws subject to the approval of the Lieutenant-Governor-in-Council, which is the provincial government. The age limit is 25 and the requirements are the same, graduates of recognized universities being required to have served two years at practical work. Examinations are provided for and a reciprocity clause is included which allows engineers from other provinces in Canada where similar laws are in force to register. The registration of others from outside the province is left to the discretion of the council. The exemptions as to those who may practice without examination are in part as in the model but no provision is made for employees of registered engineers, members of military, naval or air service or war veterans. The fee is fixed by the Council. A seal is compulsory. The provision for suspension is also similar. Penalties are $50 to $100 and $100 to $200, while suspended $100, and for misrepresentation $100 with costs. Other provisions are as in the model.

The British Columbia and New Brunswick Acts

In British Columbia the legislative assembly witnessed a stormy scene during the discussion of the bill to incorporate the Association of Professional Engineers of British Columbia, which was sponsored by Fred Anderson, an engineer and a prominent member of the government side of the assembly. The act was passed, however, on April 16, 1920. The administration is represented by a president, a vice-president, the immediate past president and nine councillors, four of whom are elected by ballot, four by the Lieutenant-Governor-in-Council, or in other words, the Government of the province, one of them representing the University of British Columbia, all being elected annually. The powers of the association are the same as in the model. There is no limit to activities. The procedure regarding by-laws is similar to that of Alberta. The age limit is 23, six years of engineering being required which may include a four year engineering course. A non-graduate must serve six years under a registered engineer. The examination board is appointed annually. Reciprocity is the same as in Alberta, and the registration of other non-residents is left to the Council. Provision is made for temporary licenses. The exemptions are as in the model. The fees are payable in advance and are fixed by the Council. A seal is compulsory. The penalties are, for misrepresentation, $50 to $300, and for false entries, $20 to $500. This act provides a money limit of $5,000 under which value a non-professional engineer may practise.

In New Brunswick the act incorporating the Association of Professional Engineers was passed April 24, 1920, and provides for management by a president, vice-president and elected councillors not to exceed 15 elected for three years. There is no limit to the Association's income. The by-laws are subject to change by two-thirds majority. The age limit is 23 years, six years' practice being required, except in the case of a graduate from a recognized engineering college, graduates of a recognized engineering college being exempt. Reciprocity is granted as in the model and exemptions are practically as proposed. The fees are established by the Council. Penalties are the same as those in the model. No minimum value is specified restricting professional engineers' operations.

The Nova Scotia Act

The last engineering act passed this year was that incorporating the Association of Professional Engineers of Nova Scotia, which is managed by a president, vice-president and 15 councillors, 7 of whom shall be be appointed by the Lieutenant-Governor-in-Council, the remainder to be elected by the Association. The president and the vice-president are elected annually, and the councillors for three years, the president holding office as councillor for the year succeeding his office. The annual income of the Association is limited to $10,000. By-laws may be changed by two-thirds' majority, subject to the approval of the Lieutenant-Governor-in-Council. Those who may practice with exemption from examination are substantially as in the model, three years practicing professional engineering at the time of passing the act, entitling to registration. Mechanical superintendents of industrial manufacturing or mining plants, having an installation of one hundred or more horsepower, are to be professional engineers. The annual fee is limited to $5. As in the case of every province except New Brunswick, the seal is compulsory. Penalties provided are $100 to $200 and costs or not more than three months imprisonment for the first offense, and not less than $200 and not more than $500, or imprisonment for not more than six months for the second offense. The striking feature of this act is that the practice of professional engineering, as described in the definition, shall apply only when the work to be done involves an expenditure of at least $25,000.

Saskatchewan

Application was made to the legislature in Saskatchewan for an act to regulate the practice of engineering, prior to efforts in the other provinces but was referred back to its sponsors. It is proposed to renew the efforts at the next session of the legislature.

Ontario

Ontario, the most important province in Canada as far as the total number of engineers practicing is concerned, has given the subject greater deliberation than any other province.

Owing to the fact that there are a number of technical organizations—acting upon a suggestion made by the Ontario Provincial division of the Institute—an advisory conference committee was established, thoroughly representative of these bodies, for the purpose of drafting an act which would be satisfactory to all concerned. This committee has just completed its labors and is at the point of submitting its draft to the various organizations interested. Provided that the proposed draft which is designed on plans similar to the acts in existance in other provinces, meets with general approval, it is expected that an effort will be made during the coming session to have a bill presented and an act passed.

Summary

It will be seen from the foregoing that engineering legislation in Canada has been promoted with a definite plan which, owing to the similarity of the various acts, may some day permit the enactment of federal legislation providing for a central examining board, provision for which has already been made in all but one of the acts passed to date. This would place the engineering profession in the same position as that now occupied by the medical profession in Canada.

Calibration of Circular Orifices Under High Heads

By F. W. Greve
Assistant Professor of Hydraulics, Perdue University, Lafayette, Ind.

THE most commonly quoted tables of coefficients of discharge for vertical circular orifices are those published by Hamilton Smith, Jr., in 1886. These tables show a constant value of the coefficient equal to 0.592 for heads above 100 ft. for all orifices from 0.5 to 12 in. in diameter. It is interesting to note that there is little or no experimental confirmation of the statement that the coefficient is independent of the size of the opening for high heads. It was to throw further light on this subject that a thorough investigation was conducted in the hydraulic laboratory of Purdue University on 1- and 1.5-in. vertical circular orifices with heads ranging up to 231 feet.

The orifices were cut to exact size in 8-in. blank flanges, the edge of the orifice in contact with the water being $\frac{1}{8}$ in. in thickness. The opening tapered outward so as to give a width at the downstream face of the flange equal to one and a half times the true orifice diameter. The flanges were bolted to a horizontal piece of 8-in. pipe, 4 ft. in length, that served as a channel of approach to which water was brought through about 100 ft. of 6-in. pipe from a 6-in., 1,800 g.p.m. centrifugal pump. The pressure on the center of the orifice was measured by a Bourdon gage, located 20 in. back from the orifice. The discharge was conveyed through a 6-in. pipe to a weighing tank of 20 tons capacity. Both the gage and the tank were calibrated previous to the experiments. The time was noted on a stop watch. A small cock on top of the channel of approach permitted the escape of any air entrained in the water.

The tests covered a range of pressures from 20 to 100 lb. per square inch. At least five tests of approximately three minutes each were made for any one condition of constant head. The cock on the 8-in. pipe remained open until all the entrained air had escaped before any readings were recorded. The presence of such air was easily detected by loud reports made as the air suddenly expanded after leaving the orifice. The flow was controlled at the pump. Reliable experiments conducted by other investigators during the progress of the tests showed the water in use in the laboratory to have a weight of 62.33 lb. per cubic foot. The tem-

perature of the water varied between 57 and 61 deg. F. The total head was assumed equal to the pressure head, thus omitting the effect of the velocity of approach. This assumption is warranted because the area of the channel of approach is 64 times that of the 1-in. orifice. The maximum possible error in neglecting the velocity of approach was 0.024 per cent for the smaller opening and 0.124 per cent for the larger.

VARIATION OF THE COEFFICIENT OF DISCHARGE WITH HEAD FOR 1- AND 1.5-IN ORIFICES

1-Inch Orifice			1-Inch Orifice			1.5-Inch Orifice		
No.	Correct Head, Ft.	Coefficient	No.	Correct Head, Ft.	Coefficient	No.	Correct Head, Ft.	Coefficient
1	47 48	0 600	9	139 88	0 597	1	47 48	0 599
2	59 03	0 596	10	157 43	0 599	2	70 58	0 599
3	70 58	0 599	11	62 98	0 600	3	93 68	0 602
4	70 58	0 598	12	174 53	0 601	4	116 78	0 595
5	93 68	0 594	13	186 08	0 600	5	139 88	0 592
6	105 23	0 595	14	197 63	0 598	6	162 98	0 598
7	116 78	0 597	15	209 18	0 599	7	168 08	0 598
8	128 33	0 599	16	220 73	0 600	8	209 18	0 598
			17	232 28	0 597	9	232 28	0 599

The results are summarized in the table. It will be noticed that there is some variation from the third decimal place of the coefficient, but in no case does this variation from the mean value exceed one per cent. Another significant fact is that the variation is irregular, leading one to believe that the variations are probably due to slight observational errors rather than to any change in the conditions of flow. There seems to be no reason for believing that the true coefficient would vary in any other than some regular manner. The mean constant value of the coefficient of discharge is 0.598 for both sizes of orifices. While the range in size was not sufficient to warrant any broad statement, it may, however, in the light of these tests, be stated that with a weight of 62.33 lb. per cubic foot and with a temperature range of 57 to 61 deg. F. the coefficient has a constant value of 0.598 for all vertical circular orifices from 1 to 1.5 in. in diameter when operating under heads from 47 to 231 ft. It is recommended that the coefficient of discharge be taken as 0.600.

British Coal Production Increases

During the week ended Nov. 20, the British weekly coal output exceeded 5,000,000 tons for the first time since October, 1918, the output being 5,211,000 tons, according to returns received by the Foreign Information Service of the Bankers Trust Co. The higher tonnage is taken as an indication that British miners have undertaken to justify wage increases tentatively granted in adjustment of the recent coal strike but conditional upon greater production. The effect of the strike on output is indicated by the following weekly figures: Oct. 16, 4,611,600 tons; Oct. 23, 12,500 tons; Oct. 30, 4,100 tons; Nov. 6, 756,300 tons: Nov. 13, 4,776,000 tons. The output of the week ended Nov. 20 was higher than the average weekly tonnage of coal mined in any year since 1913, when Great Britain's production reached the high weekly rate of 5,527,000 tons.

A striking gain in per capita production is indicated. For the first 9 months of 1920 the weekly output per person employed averaged 3.8 tons. This was increased to 4.31 tons in the week of Nov. 20. The average in 1913 was 4.9 tons. There are now almost 100,000 more persons engaged in British coal mining than in 1913. On Sept. 30 the total was 1,207,800 persons.

Monolithic Brick Road Built of Fine Aggregate

Difficulties With Fine Pit-Run Gravel Overcome by Altering Proportions and Omitting Dry-Mortar Bed

By W. M. Watson
State Highway Engineer, Topeka, Kansas

BY CONSTANTLY changing the proportions and omitting the dry-mortar bed, monolithic brick pavement is being successfully constructed in Reno County, Kan., using a combined aggregate. This road, designated as Federal-aid project No. 15, is located northeast from Hutchinson, and is being constructed on practically a level grade. The soil is a very sandy loam which will not compact readily under a roller. Construction started in July, 1919, and to the close of the 1919 season 2.4 miles had been completed. At the close of the 1920 season 10.5 miles had been completed. This project is divided into three sections, the contract price of each being shown in Table I. The design is shown by Fig. 1, vertical fibre brick being used.

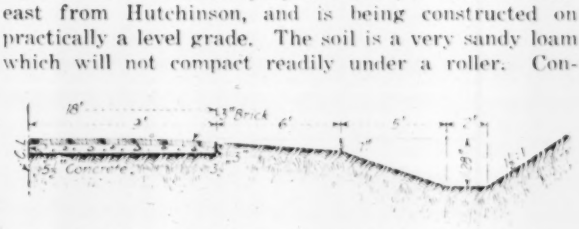


FIG. 1. HALF SECTION OF MONOLITHIC BRICK ROAD, RENO COUNTY, KAN.

TABLE I—CONTRACT PRICES FOR MONOLITHIC BRICK PAVEMENT, KANSAS

Items	Section A	Section B	Section C
Contract awarded, date	Oct. 10, 1919	May 12, 1919	May 12, 1919
Mileage	7 093	5 481	4 997
Average haul (miles)	1	1½	1½
Excavation in earth	$0 80	$0 60	$0 70
Borrow in earth	0 60	0 50	0 60
Monolithic brick	3 85	1 40	1 30
Class A concrete	35 00	15 00	10 00
Reinforcing steel	0 07	0 06	0 10
Lineal feet guard fence	1 10		
Small trees		2 00	1 00
Large trees		10 00	10 00
Rod of hedge		4 00	2 00
Section markers		45 00	45 00
Stumps		10 00	5 00
Raising bridge floor	400 00		
Cost slab per mile	$40,873	$32,110	$33,095
Cost of job per mile	47,998	35,658	37,335

Materials furnished by county. Cost of following unit prices not included in this prices: Cement, f.o.b. plant @ $0 98 per square yard; freight rate, 9½c. per 100 lb.; Cement f.o.b. plant, $2 50 per bbl.; gross freight, 12½c. per 100 lb. gravel @ $0 25 cu. yd. on bank at pit.

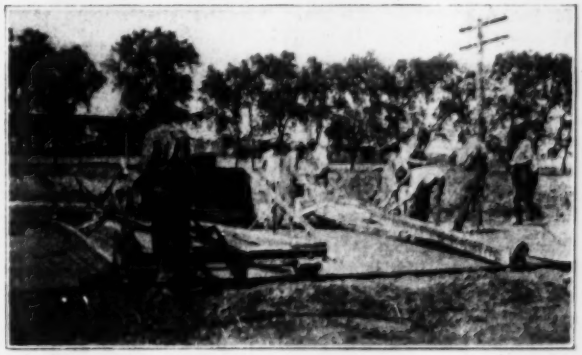


FIG. 2. CONCRETE BASE MACHINE-TAMPED DIRECTLY AHEAD OF BRICKLAYERS

No stone is locally available and on account of the abundance of local gravel and the difficulty of transporting material by rail under the present chaotic conditions of our railroads, it was decided to utilize this local material, making the mixture such as would give a strength equivalent to a 1:3:5 mix. The crushing strength of a concrete of a 1:3:5 mixture as fixed by the joint committee at 1,500 lb. per square inch was accepted and by numerous tests of the aggregate the curves of equivalent strength were derived as shown by Fig. 3. The bulk of the coarse aggregate passes a 1-in screen. As pumped from the river-bed pits the gravel is screened to remove a proportion of the fine aggregate before loading, but the disposal of the surplus fine material is considered to be in excess of the cost of extra cement required.

At the beginning of the work the base was poured at a stiff consistency and struck off by the Parrish type of multiple steel template, using a ¾-in. dry sand-cement bed. The brick were laid directly on the sand-cement bed before the base attained its initial set. The gravel aggregate, containing very little coarse material, produced a concrete with which it was difficult to obtain satisfactory results. When mixed sufficiently dry to permit the other operations it contained too little water properly to saturate the dry cushion, with a consequent separation between the base and brick surface. When made with enough water to give the

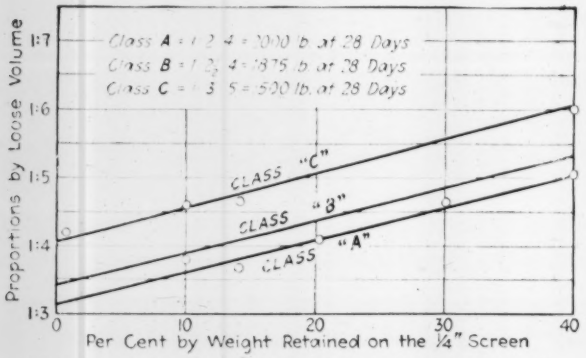


FIG. 3. GRAPH OF EQUIVALENT PROPORTIONS FOR RENO COUNTY GRAVEL

dry cushion a proper amount of water, due to the absence of coarse material, the concrete had little stability, rendering the operations of rolling and grouting exceedingly difficult and making it almost impossible to secure a smooth surface. This trouble has been overcome by the use of a mechanical tamping machine operated directly on the base, and by eliminating the sand-cement cushion. A marked improvement is noted by reason of this change, not only in the surface of the pavement but in the adhesion as well. For example, Fig. 4 shows space where five rows of brick have been removed after the base was prepared with a tamping machine and the brick rolled. Not only does mortar tamped to the surface firmly adhere to the brick but from ¼ to ½ in. of mortar squeezes up between the bricks giving greater assured resistance to the sliding of the brick along the base, due to difference in coefficient of expansion. A much denser concrete in the base is also assured. Rolling is done by means of a hand roller and the joints are grouted with a 1 to 1 mortar in three applications.

Successful use of the combined aggregate depends upon very close inspection. An inspector is kept both in front and behind the mixer. One is employed to check the proportioning which is varied continually to insure the standard strength concrete. As a check on the strength of concrete obtained, cylinders of the actual concrete used in the base are taken each day and as often as the mix is changed. These cylinders are cured alongside the pavement under as nearly the actual curing conditions of the pavement as is possible. These cylinders are shipped to the laboratory at frequent intervals and tested.

FIG. 4. APPEARANCE OF TAMPED BASE WHEN BRICKS ARE REMOVED AFTER ROLLING

Studying Power Possibilities on the Tennessee

An engineering and economic survey of the Tennessee River, its tributaries and its basin is being made by the Corps of Engineers, U. S. Army. The survey includes a study of the resources of the basin with the idea of determining the influence of water transportation on their development and the amount of tonnage that they might contribute for transportation by water. The work is being done under a Federal appropriation with co-operative work by the Tennessee River Improvement Association. The mountain areas which fringe the Tennessee Basin are being mapped aërially. One of the important features of the report will be the effect on the main stream by power developments on a non-navigable tributary. This question is a live one because of the many proposed water-power developments. The Parr Shoals dam on the non-navigable Broad River, near Columbia, S. C., so affected the flow of water in the Congaree River as to make navigation impracticable. The Chattahoochee River is navigable to Columbus, Ga. When a large power plant above Columbus finds it necessary to draw out the maximum quantity of water that it uses boats frequently must be tied up until the needs of the power plant have been supplied.

Observations on a Pacific Coast Trip

By Frank C. Wight
Associate Editor, *Engineering News-Record*

San Francisco, the Western Metropolis

IN THAT perfect short story "A Municipal Report" O. Henry quotes—to disprove later—a remark of Frank Norris: "There are just three big cities in the United States that are 'story cities'—New York, of course, New Orleans, and, best of the lot, San Francisco." That is as may be. It is no part of the duty or ability of an engineering editor to evaluate the fictional possibilities of the cities, but the comment sticks; San Francisco *is* individual. It is supposed to be the West incarnate; perhaps it is, but more than that it is itself. Some few cities in the United States have grown up; the rest still suffer growing pains, they have not found themselves. They worship at the shrine of the "booster" and their prophet is the Board of Trade secretary. San Francisco is not like that. It is serene and confident; it has arrived.

It is strange enough for an Easterner to find this spirit in San Francisco, for all his training and reading have led him to think differently of the Pacific metropolis. He expects to be set upon on his arrival by groups of enthusiastic native sons who will point out to him the unequalled advantages of climate, of resources and of a man-to-man friendliness peculiar to the Coast and to be compelled to listen to disaparaging comments on his own choice of residence.

It may be invidious to remark that there are cities on the Coast where his expectations are fully realized, but not in San Francisco. It is not that the advantages are not there; certainly the pride in his city and the conviction of its complete superiority are as strong in the San Franciscan as in any other but he has reached that desirable height where he is willing for his city to speak for itself. He has become a metropolitan.

Engineers Have Wide Field

It should be understood that these comments are based on an association almost entirely with engineers. Possibly ten days spent among the merchants or real-estate men would result in a change of mind. Their activities are in and of the city itself and self advertising is of the essence of their business. To the engineer, on the contrary, the city is but the center from which radiates out over all the Western country the many activities which are the sources of growth. And that is why San Francisco is different from other Western cities. It is more truly metropolitan; it is the "mother city" of the West. Now, to be metropolitan is considered in some quarters to be more a vice than a virtue. It has become the fashion to decry the big cities as the source of all evil and to belittle those who find their work there. But so long as a country or a part of a country continues to grow there will gravitate to the reservoir of the big city the money and brain power which flows out to nourish the smaller centers which do the actual producing. The function of the reservoir is quite as important as that of the producing field or factory or mine.

This, then, is what is most impressive regarding engineering in San Francisco. The engineers there are part and parcel of the West. In their own city they have much to do; the wonderful finished appearance of that down-town section which only fourteen years ago was laid waste is mute testimony of their work; the beautiful boulevards, the time-saving highway tunnels and the well-developed harbor show their handiwork. But it is in the highways and water powers and irrigation projects from the Rockies to the Coast that the engineers of San Francisco are most in evidence. There are more men there with practices reaching far out into the back country than anywhere else save possibly Chicago and New York.

In spite of its individuality San Francisco savors much of New York. It is partly this same metropolitan atmosphere but it is more its geographical location, for it reproduces remarkably the conditions that helped make Manhattan Island the business focus of the country. There is the same comparatively narrow peninsula—wider of course at San Francisco and now an island at New York—the same spacious harbor immediately on the open sea, the same, though smaller, river reaching up into a rich hinterland, and the same transcontinental terminus across the bay in one case, the river in the other. Both cities are wonderfully accessible from the ocean, both are comparatively inaccessible from the mainland. Because of the former they have both become great ports; unless the latter defect is cured they both must suffer.

Harbor Problem Like New York's

In New York today the isolation from the West is a source of constant worry and its remedy probably the most vital engineering problem in the East. San Francisco, on the other hand, has not yet begun to consider seriously its eastern approach. It is true that the matter of a trans-bay bridge is alive and the many proposals for different types of structures at various crossings are having more respectful hearing than ever before. The distances are so great—it is nearly four miles across the bay from the San Francisco ferry house to the Oakland mole—that the problem is unprecedented in size, but sooner or later some kind of crossing will have to be provided, not only for the large passenger traffic but also for freight. As regards the latter, the situation quite parallels that of New York. Except for the excuse of existing conditions, it is ridiculous that ocean steamers should dock on the San Francisco peninsula when there is available such admirable ground for terminals on the east side of the bay, directly connected to the transcontinental railways. Efforts have been made, are being made now in fact, to develop large terminals on this mainland, but San Francisco, like New York, is powerful in its own bailiwick, and precedent and financial control are hard to beat.

The time is coming, though, when this east shore of San Francisco Bay will be developed as a great ocean port. The obvious economics of the situation cannot forever be disregarded. And probably when that time comes, there will come with it the establishment of a great joint port, such as will surely come in New York. It may be that there will be an extension of the metropolitan district in San Francisco to embrace all that now comes within its real area, for its citizens feel keenly the passing ahead in population of Los Angeles, which takes in now practically its entire county. But even if this modern method of increasing population is not followed, the co-ordination of the

port may be brought about much more simply than at New York because the transbay district is in the same state and may be brought, by mere legislative enactment, under the jurisdiction of the State Harbor Commission, which already controls the port of San Francisco. There need be done of the interstate jealously which bids fair to retard New York's development.

The harbor of San Francisco is busier than any other on the Pacific. In multiplicity of wharves it is the largest and also in established steamship lines. While the business is not up to war years, the trade with South America and Hawaii is good and the passenger service, which is very large here, is crowded. The types of piers is between Eastern and Northwestern practice; that is, they still depend a good deal on ship's winch and stevedore loading but do have railway connections and fairly wide piers and sheds. The tendency of design, however, is toward a still wider pier and shed and a maximum of machine handling. Everyone who has to do with marine structures is, of course, tremendously concerned with the current difficulties with the teredo and his smaller neighbors, which have been reported in these columns, but the solution for the trouble has not yet been reached. On the San Francisco side, where sewage polution is high, the limnoria is particularly active, even destroying in a comparatively short time certain kinds of treated piles. Concrete, taking it by and large, is behaving well in the harbor. There are evidences of deterioration but there is much more that is solid and the solution seems to be in better concrete with thick covering of the steel.

Hetch Hetchy Work Typically Western

The Hetch Hetchy water-supply project is being carried on rapidly by the city, which is also now about ready to take over the local private water company. Hetch Hetchy is a story in itself; in such comment as this it is enough to say that its many miles of tunnels and yards of dams are representative of trans-Rocky engineering—high mountains, isolated camps, steep inclines, long construction railways, great distances engineering far away from the office and the telephone to the material and supply man in the next street.

No one can spend much time in down-town San Francisco without getting worked up over the miserable traffic conditions on Market St., the main artery of the town. Some years ago the city built a municipal street railway to compete with the private company and did what it would never have allowed anyone else to do, laid an extra two tracks on a street which already had two. Market St. is wide; otherwise one would not cross it at all, but even so one crosses it now at imminent risk of life and limb, particularly as the motormen run more or less at their own sweet will, and both pedestrians and motorists—to say nothing of the crossing policemen—seem to regard such traffic rules as there doubtless are as whimsical devices of some unauthorized theorist. Successfully to dodge four street cars, six automobiles, and thirty-six pedestrians all bound in different directions becomes a feat to be proud of.

Industrial conditions in San Francisco are about the same as elsewhere on the Coast. Being a financial center, the current tightness of money is perhaps better appreciated than in the other cities and the depressing reaction on new projects was felt somewhat earlier. There is a great deal of prospecting being done, mainly in irrigation and water-power, and engineers as a rule are busy, but the prospecting is mostly office work, and actual construction is awaiting a more favorable money market. Meanwhile there is quite a good deal of building construction going on in the city. Labor is reported much easier; that is, the men are working harder and there are more men available. Wages have not shown any signs of coming down, nor is there any indication of a loosening of the grip which union labor has had on San Francisco for years. So long as the unions continue so powerful there is little hope of pronounced industrial growth. New manufacturing enterprises will want to go to sections of the West, notably the Southwest, where labor, up to now at least, has been more reasonable.

They will tell you at San Francisco that there are more "Sunday supplement" engineers there than anywhere else in the world. More wild schemes, they say, are born and circulated there, and they warn you to discount all extravagant engineering stories which circulate in the daily press under the San Francisco date line. There is no good explanation for this unless we return to the metropolis theory, for New York, too, harbors more engineering "nuts" than any city in the East. It must be because there is more money in the big centers looking for release and the dreamer can find more sympathetic attention from those who want quick and multiplied turnover. But beyond that there is in San Francisco the old pioneer spirit which took chances and in the main made good. The forty-niner has left the native son the heritage of trying anything once. He will listen to schemes and apply theories that more prosaic folk know won't work, and every once in a while the scheme does work and the theory proves practicable.

Traffic on Wayne County Roads

Comparison of traffic counts made in 1920 with those taken during 1912 upon the main roads leading out of the city of Detroit just outside of the city limits reveal a tremendous increase in motor vehicle traffic and decrease in horse-drawn traffic. Traffic counts taken this year upon Woodward Avenue showed in excess of 14,000 vehicles for a 14-hr. day, the average for a week being greater than 10,000 vehicles per day. Traffic counts were taken during both years at the same points on the same road. The figures given in the above table are the averages for a week.

1912—24-HOUR COUNT

Road	Horse-drawn	Auto, Touring	Trucks	Total
Woodward	322	2,146	122	2,590
Gratiot	732	437	40	1,209
Grand River	471	528	53	1,082
Michigan	364	549	23	936
River	125	370	13	508
Van Dyke	389	209	20	618

1920—14-HOUR COUNT

Road	Horse-drawn	Auto, Touring	Trucks	Total
Woodward	90	9,440	1,007	10,537
Gratiot	46	3,203	315	3,564
Grand River	32	2,040	486	2,558
Michigan	17	1,979	613	2,609
River	33	1,619	329	1,981
Van Dyke	102	1,402	590	2,094

Trend of Highway Development —A Survey

THIS IS THE NINTH *of a series of staff articles on the highway situation. It deals with the policy of concentrating on construction brought forward from a previous year, with the transportation shortage of materials and with the regulation of the weight of traffic.*

The tenth article in the series will appear in next week's issue.—EDITOR.

Illinois Practice

ILLINOIS began the season of 1920 with 400 mi. of pavement uncompleted under contracts awarded in 1919. The policy of 1920 has been (1) not to increase largely the contract mileage of pavement but to concentrate on the completion of the work in progress; (2) to award grading contracts ahead on the 1,000 mi. of pavement originally contemplated for 1920 construction; (3) to advance experimental studies of pavement types and structure with a view to improvements in design; (4) to provide plans for regulating vehicle weights, which, uncontrolled, are in some localities destroying pavements, and (5) to develop the extension of state maintenance.

In a word, Illinois stopped letting contracts for paving in 1920. The reasoning ran as follows: Illinois began the year's highway construction with a large mileage brought forward from 1919; two plans of procedure were practicable to secure a large mileage of completed road, (a) to let new contracts and possibly have the extensive construction produce a large aggregate mileage, or (b) to cease to let contracts and concentrate on a definite mileage; analysis of the governing conditions led to the conclusion that equal progress would be made and greater economy secured by ceasing to award contracts. An examination of the reasons for and the results of this policy is of value particularly because other states which, like Illinois, brought forward a large mileage of uncompleted 1919 contracts adopted the opposite policy—of continuing to let contracts.

THIS YEAR'S WORK

About 575 mi. of pavement was placed under contract in 1919. This mileage had absorbed nearly all the contractors of the state available for pavement construction. These contractors had been able to complete only about 175 mi. of pavement because of the scarcity of labor and the transportation shortage of materials. As the working season of 1920 approached there was little indication of either cheaper labor or a more ready movement of materials. When, in March, contractors were asked to bid on new work only a few were free to undertake any considerable mileage and the prices which they asked were from 33⅓ to 40 per cent higher than the prices on the 400 mi. of contracts brought forward from 1919.

It was concluded under the circumstances that if contracts for any considerable new mileage should be awarded at the increased prices the contractors for this new work (1) would be in position to bid higher prices for materials and labor than could the contractors operating under 1919 prices, and (2) would put the old contractors at a disadvantage by competing for a car supply not sufficient for the work in progress. There was also reluctance to incur the higher costs because of a belief that the future would bring a readjustment of commodity prices and that with readjustment would come cheaper road construction. Another motive for proceeding slowly was that bonds would have to be sold to finance a much greater mileage of construction and, if sold then, a discount must be taken. To fill in gaps in Federal-aid projects 50 mi. of new pavement were placed under contract and no further bids for pavement were asked. In addition county construction of paved road was discouraged, except where large centers of population were to be served by the new mileage.

Looking back at the season's experience, the action taken is considered to have been justified. At the close of the season some 320 mi. of pavement had been completed. Could materials have been brought to the work by the railways the entire mileage under contract would have been finished. The organization and equipment were on the ground and labor was available but cars to transport material could not be had. On this evidence alone it is held that had a much larger mileage been placed under construction the completed mileage would not have been increased.

GRADING; CONSTRUCTION PRACTICE

While paving contracts were curtailed in 1920, the opposite policy was adopted in respect to contracts for grading. On the 1,000 mi. of bond-issue highway, which it had been the original intention to pave, contracts were let for the heavy grading operations. The thought was that the prosecution of grading would not materially interfere with progress in paving, that with the controlling heavy grading operations completed future paving operations would proceed with fewer delays, and that by completing this grading well in advance time would be allowed for consolidation and a better road structure be secured. This grading work, it may be stated, included permanent small bridges and culverts. In round figures nearly $3,000,000 were involved in these grading contracts. As a rule, competition for the work was active and the prices were reasonable.

Paving methods present no unusual features. Central mixing plants and wet-batch haulage (generally by truck), central proportioning plants and dry-batch haulage (generally by industrial railway), and various methods of operating from stock piles on the ground were employed. In wet-batch haulage the principal development was the use of one-ton trucks, with oversize pneumatic tires and turntables to protect the subgrade, as was described in *Engineering News-Record* Aug. 19, 1920, p. 356. In dry-batch haulage by industrial railway an interesting side light on the value of close co-ordination of operations was furnished by the work of Allan J. Parrish, some details of which were noted in *Engineering News-Record* July 29, 1920, p. 234. Complete records for the season are not available but for 14 working days this contractor averaged 565 ft. per day of 18-ft. 8-in. concrete pavement and maintained a record throughout the season of well over 450 ft. per working day. Explanation of this continuous good progress lies in the one word *management*, which included keeping the supply of materials constant.

As indicated previously, transportation shortage of materials has been the crowning obstacle to highway

construction progress in 1920. Its causes and effects are typical for the Mississippi Valley states and they probably will continue in a less virulent form in 1921, and, therefore, as summarized by the Illinois highway engineers they deserve attention:

In the latter half of 1919 contractors were faced with a shortage of cars—first, because of the strike of the railway car repairers; second, because of the steel strike, and, third, because of an embargo placed on open-top cars due to the impending coal strike. Profiting by the 1919 experience every effort was made by the contractors in 1920 to store sufficient sand, gravel, stone and cement to carry them well into the season; to this end they were given all possible assistance by the department. It was found, however, that transportation conditions were worse than in 1919. First came a more pronounced shortage of cars; this developed early in the year, when it became almost impossible to get box cars for shipping cement. The cement companies resorted to the use of stock and open-top cars in order to overcome the shortage. Second, this shortage was greatly increased by the switchmen's strike. Third, the coal situation, which tied up a very large number of cars for a considerable period of time, became acute much earlier than usual, resulting in an order being issued by the Car Service Commission restricting the use of open-top cars to 50 per cent of the requirements of any producer of materials, and also providing that open-top cars could not be used for carrying commodities that could be as readily shipped in other classes of equipment. This order prevented the sand, gravel and stone producers from getting sufficient cars to take care of the highway contractors and also prevented the shipment of cement in open-top cars. Fourth, the order issued by the Car Service Commission was followed by an order from the Interstate Commerce Commission which provided that coal cars could be loaded with other commodities only when returning in the direction of the mines.

These two orders issued from Washington, which were made more rigid as the season advanced, demoralized shipping conditions as applied to road-building materials and made it impossible for the contractors to depend upon regular deliveries. Practically all of them have been obliged to shut down at frequent intervals because of the shortage of materials, and some of them for weeks at a time. The department has kept in constant touch with the requirements of the contractors, with the material producers and with the railroad officials, endeavoring to assist in procuring cars and securing shipment of materials so as to keep as many contractors as possible at work.

At best, with about one hundred paving outfits in commission only a few over fifty were ever in operation at one time.

Prevented from proceeding as rapidly (800 to 1,000 mi. annually) as had been planned for the paving of the 4,800-mi. bond-issue road system, plans are being developed to bring this system as it stands under state maintenance. The thought is to establish a truck patrol system with sections of 20 to 30 mi. In this connection it may be noted that on the hard-surface mileage now maintained wholly by the state gang maintenance is becoming inadequate in certain localities, and that here patrol maintenance will probably be substituted in 1921.

The standard hard pavement in Illinois is an 18-ft. concrete slab uniformly 8 in. thick or, for other types of construction, a design of equivalent quality. With a view of determining the need of an improved design an experimental road, which will be described in a future issue, has been constructed for observation. These studies will include pavement design and construction and subgrade conditions. While final conclusions are not determined, the indications are that future developments will not be toward a lighter slab design. In this connection the fact is noted that this year a number of pavements have been destroyed by heavy trucks. A more rigid regulation of vehicle loads in 1921 is therefore contemplated. Illinois is feeling the same pinch of unregulated traffic which is distressing the states of the East, as was emphasized in the article of this series which reviewed practice in Connecticut, Massachusetts and Rhode Island. The department officials thus express the situation:

A pavement paid for by the public and which is ample to carry 99 per cent of the traffic cannot be permitted to be totally destroyed by a few unreasonably heavy trucks representing a fraction of 1 per cent of the traffic. The solution lies in arriving at the proper beam strength of pavements to meet the weight of the economic load and then through legislation placing the proper limit on weights of loads, and enforcing the law rigorously.

At the close of the season there will have been put into service approximately 450 mi. of hard-surfaced roads built in 1919 and 1920. When this is done it is proposed to place patrolmen upon them with devices for determining the weights of loads, and through these officers put the law now on the statute books of the state into effect. Only by such a system can these roads, costing the taxpayers millions of dollars, be protected from wilful violators of the load-limit law. Already a number of sections of state-constructed roads in Cook County have been either partially or entirely ruined by heavy truck traffic.

The plans to regulate vehicle weights and to extend patrol maintenances and policy of keeping reasonably small the margin between the mileage under contract and the mileage completed are the outstanding developments of 1920 highway practice in Illinois.

Economical Loading of Seagoing Dredges Studied

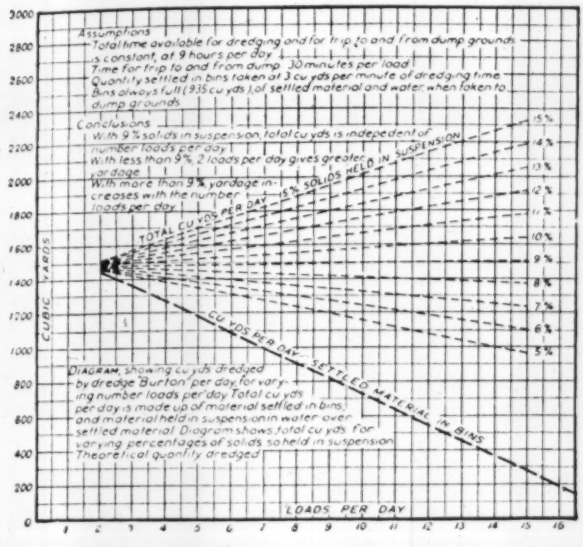
With More Than 9 Per Cent of Silt in Suspension Yardage Increases With Number of Loads Per Day

By G. S. Phelps
U. S. Assistant Engineer, Cleveland, Ohio

Conclusions of practical importance to dredgemen excavating silt, which settles slowly in the hoppers of seagoing dredges, are contained in an article in the November-December, 1920, issue of the Military Engineer. *Briefly (1) with 9 per cent of solids in suspension, the total yardage is independent of the number of loads per day; (2) with less than 9 per cent two loads per day gives greater yardage and (3) with more than 9 per cent, the yardage increases with the number of loads per day.*—Editor.

Investigation was made as to the number of loads per day which should be dredged at Cleveland Harbor with the seagoing hopper dredge *Burton*. At this harbor dredged material running overboard with the overflow is a waste of money, as it settles within the dredged area. The material was a fine silt, which settled slowly in the bins. The time required for one round trip to the dumping grounds was about 30 min. The total time available for dredging and dumping is assumed at 9 hr. per day. Two loads per day could be dredged with a pumping time of 4 hrs. each, which with the two trips to the dumping grounds consumed the 9 hr.

While the dredge worked on that schedule it was found that a fairly constant average of about 720 cu.yd. of settled material in the bins was secured with each load, or at the rate of 3 cu.yd. of settled material per minute of dredging time. The capacity of the bins was 935 cu.yd. The dredging time per load was varied from 30 min. to 4 hr. and it was found that the amount of settled material in the bins


Assumptions
Total time available for dredging and for trip to and from dump grounds is constant, at 9 hours per day
Time for trip to and from dump 30 minutes per load
Quantity settled in bins taken at 3 cu yds per minute of dredging time
Bins always full (935 cu yds.) of settled material and water when taken to dump grounds
Conclusions
With 9% solids in suspension, total cu yds is independent of number loads per day
With less than 9% 2 loads per day gives greater yardage
With more than 9% yardage increases with the number loads per day
TOTAL CU YDS PER DAY
SOLIDS HELD IN SUSPENSION
CU YDS PER DAY SETTLED MATERIAL IN BINS
CUBIC YARDS
LOADS PER DAY
DIAGRAM showing cu yds dredged by dredge 'Burton' per day for varying number loads per day. Total cu yds per day is made up of material settled in bins and material held in suspension in water over settled material. Diagram shows total cu yds for varying percentages of solids so held in suspension. Theoretical quantity dredged

PERFORMANCE OF DREDGE "BURTON" UNDER DIFFERENT OPERATING CONDITIONS

was practically constant at 3 cu.yd. per minute of dredging time, irrespective of the length of the dredging period. Thus when six loads per day were taken, the total time dredging was 6 hr.; 3 hr. were spent going to and from dumping grounds, and the quantity of measured settled material in the bins was about 1,080 cu.yd. for the day, still 3 cu.yd. per minute of dredging time. The question arose as to whether the solids held in suspension in the water above settled material in the bins were sufficient to justify the greater number of loads per day. The settled material had fallen from 1,440 to 1,080 cu.yd. per day. It is apparent that volume of dirty water carried to the dumping grounds was increased from 2 (935) — 1,440 = 430 cu.yd. with two loads per day, to 6 (935) — 1,080 = 4,530 cu.yd. with six loads, an increase in volume of water carried of 4,200 cu.yd. The loss in settled material was 360 cu.yd. If the water contained 8.76 per cent solid material held in suspension, then the loss in settled material was exactly balanced by the gain in suspended solids; if less than 8.76 per cent, two loads per day gave the greater total of settled and suspended material; if more than 8.76 per cent, the shorter dredging period and greater number of loads were better.

It appears then that in this case 8.76 per cent is the critical percentage of suspended solids at which economy definitely demands a change from a policy of full loading of bins to one of many loads per day, the more the better, limited only by the times required to fill bins with muddy water. Satisfactory sampling of the water held in bins has not been made, since the dredge left the work before this was done. It is believed, however, that in a great many cases where the material consists of fine silt the solids held in suspension will considerably exceed this critical percentage, and that in such cases the dredge would better become a "water wagon" and take as many loads as possible of water to the dumping grounds. The illustration shows graphically, for varying numbers of loads per day, the total yardage which would be obtained under conditions as outlined for Cleveland dredging, with varying percentages of suspended solids. The importance of taking this suspended matter into account, when considering the total quantity of material carried, is strikingly illustrated by this diagram.

Three Canadian Provinces Lack License Laws

Saskatchewan, Ontario and Prince Edward Island are now the only provinces in Canada that lack legislation regulating the practice of professional engineering. Steps are being taken to pass bills in these provinces.

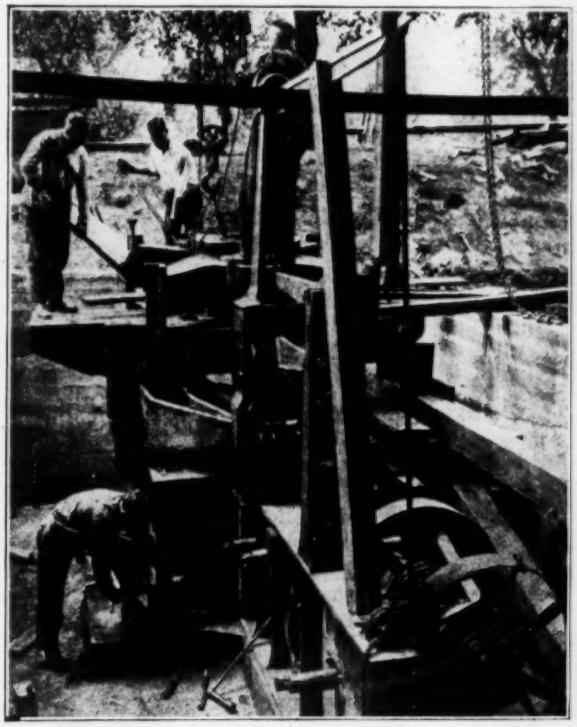
Million Pound Testing Machine for Forest Products Laboratory

By L. J. Markwardt
Assistant in Charge, Section of Timber Mechanics, Forest Products Laboratory, Madison, Wis.

A PROBLEM of no less interest than the conducting of special tests for which it was designed is that involved in the erection of the new million-pound testing machine being added to the equipment of the Forest Products Laboratory. The mammoth machine is of the two-screw type and has an over-all height of 45 ft., including the superstructure above the weighing platform, which will enable it to accommodate columns up to 30 ft. or tension members up to 27 ft. in length.

The total weight of the complete machine is approximately 160,000 lb. The heaviest single piece is the weighing platform, on which one of the men is standing in the accompanying photograph, taken during the progress of the erection. This part weighs 15 tons.

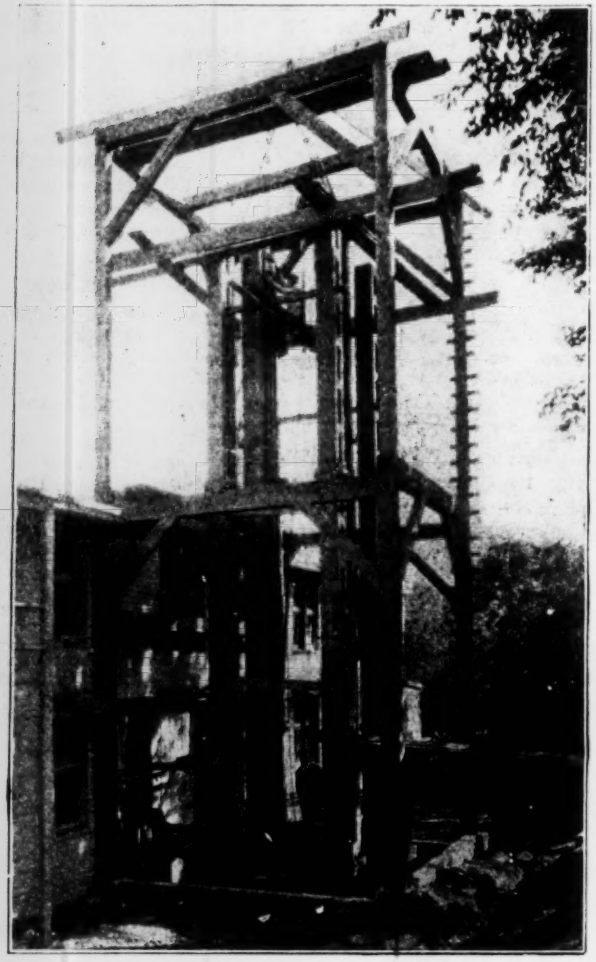
The base of the machine is placed in a pit, with the weighing platform at floor level. A timber frame-



ERECTING NEW TESTING MACHINE AT MADISON

work constructed around the machine first served the purpose of furnishing an erection support and later will serve as a housing framework. In housing the machine removable doors and windows will be provided to afford an opening the full height of the machine and the width of the screw clearance. Thus it will be possible, by constructing extensions to the weighing platform, to test built-up members such as roof trusses and girders of considerable spans.

The unique feature of this machine and the thing that differentiates it from most of the other machines now in use is its adaptability for testing pieces of great length. Moreover, this machine, unlike many other large machines of similar capacity, can be used



FRAMEWORK WILL SUPPORT FUTURE HOUSING

for testing in tension as well as in compression and bending.

One of the first investigations contemplated is a study of wooden columns, including the development of column formulæ, and an analysis of the effect of defects of wood on strength. It is generally recognized that present data on wooden columns are exceedingly meager, and that engineers have long been in need of more complete information on this subject.

Tonnage of Structural Materials Transported

Despite the car shortage a considerable tonnage of structural materials was transported during the quarter ended June 30, 1920, as shown by a statistical compilation made by the Interstate Commerce Commission covering 70 commodities carried on Class-1 roads—those with annual operating revenues above $1,000,000. The tonnage of certain building materials carried during the second quarter was as follows:

	Tons
Cement	3,829,734
Bar and sheet iron, structural iron, and iron pipe	6,137,342
Brick and artificia stone	4,145,520
Lime and plaster	1,144,336

Each of these items shows an increase over the tonnages transported during the first quarter. Comparisons with the corresponding quarter of the preceding year are not yet available.

Permanent Record of Field Changes in Highway Construction

By Jasper A. W. Davis
Logan County Road Dept., Logan, W. Va.

Records in highway construction are often regarded as of little importance. In enterprises where public funds are being expended records ought to be made so complete as to leave little to be desired. Often those who have charge of the work technically, have passed through the period following their graduation or apprenticeship in meeting setbacks to their idealism and have lost the concientiousness that they could well have kept. Such circumstances produce an individual who pays little attention to absolute economy and puts the "getting by" and the "financial remuneration" above service.

The expenditure of public funds is a sacred trust. Highway engineers are now receiving large sums to expend. There are county bond issues up into the millions; there is aid offered by state and federal departments. True, the trained man receives poor compensation for his years of study and endeavor, but that cannot justify loose methods in keeping records. The public is entitled to records and they should have them.

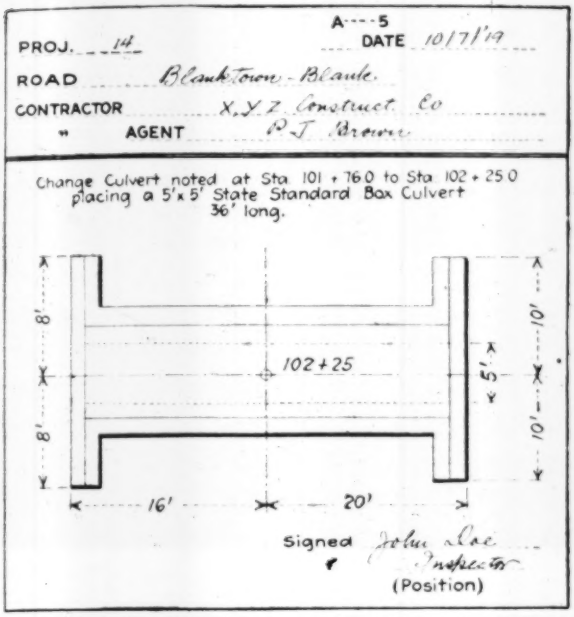
Unforeseen Changes Frequent

Plans are generally at hand before a contractor begins his work, but few sets of plans are so complete and so perfect as to go through without changes in construction. A pipe may be needed at some point not indicated on the plan, a rip rapped embankment may be deemed more economical than a retaining wall along some waterway, or the reverse; or it may develop that a stone underdrain is necessary at some point. Often a change in the alignment becomes possible and the relocation most desirable. With the general and flexible unit price contract used in much of the work let, these changes, additions and deductions can be made easy.

A changing engineering personnel is an added reason for the more elaborate system of record keeping. The engineer, his assistant or inspectors, may and very often do, verbally authorize a change in some of the details. Possibly before the monthly estimate is made up and more probably before the final estimate is taken, that individual may be off the job or has forgotten the whole or a part of what transpired. Those buried details are then hidden and forgotten until expensive digging reveals them—the records failing to show the information. Municipalities have had the experience of unravelling records concerning their sewer, water and gas pipes, and telephone and power conduits, and tomorrow there will be untangling on our highways.

Three counties I am or have been familiar with, completely neglect their permanent records in the construction programs. Simplicity and accuracy are essentials of a system for keeping permanent record. It is believed that the system herein outlined has these characteristics.

Each authority should carry a pad of order-form blanks with duplicates and triplicates. Such a form could be made similar to the one herewith illustrated. Upon these blanks should be noted any changes in construction, or any information supplied not on the plans and any failures to conform with plans, specifications



SUGGESTED METHOD FOR NOTING CHANGES IN CONSTRUCTION

or instructions, numbered and written up with sketches where a sketch will aid in the explanation, and signed by the person giving the information. One copy should be left with the contractor's agent, one copy to be filed away in the office and the third copy to be left in the book for reference by the individual.

Changes and orders may well be cross referenced with the engineers field book to aid in the tying the whole together.

The inspector could well keep a record of such information as materials brought to the job, labor and machinery, their quality and cost, remarks, etc. This record would act as a double check on the efficiency of the organization and make cost data readily available for use in similar work and estimates.

Upon completion of the work, these instructions may be easily grouped and the tabulation made. The original tracings may be then gone over and the data, so gathered together, supplied to them. Completed, these tracings showing the finished work could well be blueprinted and the sets of prints filed where readily available for the information of those who have the right to it. In the case of aid projects, prints could be supplied to either or both the state and federal departments as final records.

Up to the present time the writer has not seen or heard of a system used in highway construction work.

Drainage Work in Illinois

Drainage projects in the larger valleys in Illinois experience difficulty in organization owing to the number of land owners and the large amount of preliminary work and the expense involved in preparing a petition. According to a paper by F. W. De Wolf and G. W. Pickels, presented at the recent meeting of the National Drainage Congress, some land owners think the state should bear all the expense, but the majority are willing to pay their share of the cost though not willing to give the time to promote such projects.

Railway Maintenance in 1920

Despite Heavy Traffic, Plant in Better Condition Now than at Beginning of Year, but Ground Lost Under Government Control Not Fully Made Up

By Julius H. Parmelee
Director, Bureau of Railway Economics, Washington, D. C.

ADEQUATE maintenance of plant is vital to the welfare of any industry, and to none more so than to the railways, whose plant—especially the roadbed and equipment—is peculiarly subject to weather conditions and to operating wear and tear. A locomotive is literally a power plant on wheels, and must manufacture and deliver power at the drivers while moving rapidly around curves, over rough sections, up and down grades, and under varying conditions of cold, heat, and storm. Similarly, cars are subjected to the pounding and grinding of rapid movement, while under obligation to carry heavy loads and deliver them in good order at destination.

Railway maintenance, then, is a subject of vital importance to the industry. In normal pre-war days, as for example during the three-year test period of 1915 to 1917, the American railways spent a billion dollars annually on the two maintenance accounts, maintenance of way and of equipment. Relatively considered, out of every dollar of total operating expenses in that period, 17.7c. was expended for maintenance of way and 24.7c. for maintenance of equipment, or 42.4c. in all. Clearly, any element of expenditure that bulks so large as maintenance calls for most careful consideration, if only as a matter of financial policy. More important still, operating efficiency is involved in the maintenance of railway plant to such a level that it can function prompty and effectively at all times.

Under Federal Control

During the 26 months of federal control of the railways, from Jan. 1, 1918, to March 1, 1920, the railway plant was subjected to terrific pressure of traffic. Freight and passenger traffic in 1918 was the heaviest recorded up to that time. Freight traffic declined somewhat in 1919, but passenger traffic was even greater than in 1918. Yet the maintenance applied to roadway and equipment was less than normal, certainly below what the wear and tear of the unusual war traffic called for. This was due in part to lack of available labor and materials, and in part to the financial position of the Railroad Administration, which was confronted with heavy operating deficits and was finding it difficult to secure appropriations from Congress. Without going into an extended discussion of the moot question of under- or over-maintenance during federal control, there is considerable evidence, some furnished by the Director-General of Railroads himself, to the effect that railway maintenance in 1918 and 1919 was not all that the needs of the situation demanded. Statistics are available pointing to the conclusion that the railway properties came back to their owners on March 1 of last year less fit for service than when the government took them over; by how much less, it is difficult, and perhaps needless, to state with exactness at this time.

In this connection, citations from the Interstate Commerce Commission and the railways may not be out of

order. In a recent address Daniel Willard, of the Baltimore & Ohio, speaking of railway equipment, said:

"While the government did purchase, during the period of federal control, 100,000 freight cars and approximately 2,000 locomotives, it is only fair to say that the additional equipment so purchased was probably less in the aggregate than the equipment actually worn out during the same period,—so that when the railroads were returned to their owners on the first of March last, they undoubtedly had fewer available engines, freight cars and coaches than was the case when they were turned over to the Government on Dec. 28, 1917. This statement is of course not made in criticism, but in order that the facts may be understood."

Referring to the question of railway maintenance during federal control, S. M. Felton, of the Chicago Great Western, has made the following statement:

"Both the tracks and the locomotives had been subjected to the hardest kind of service without being maintained to as high standards as under private operation."

Perhaps the strongest evidence on the subject is furnished by the Interstate Commerce Commission in the annual report submitted to Congress a month ago. In the commission's discussion of the emergency service orders issued by them during the months of May to September, 1920, with the reasons therefor, appear the following significant statements respecting the deteriorated condition of the railway plant at the close of federal control (italics mine):

"The problem was forced upon the carriers and upon us as to how the demands of commerce for the movement of an extraordinary amount of tonnage could be met with *an impaired transportation machine.*

"It is clear that the problem cannot be solved without *substantial additions to equipment.*

"The foundation of each of these orders has been in finding that, because of *shortage of equipment* and congestion of traffic, an emergency has existed which required immediate action."

Under Private Control

Since March 1, or for the past ten months, the railways have been operating their own plants, and it is a fair question what they themselves have done as to maintenance. There are two ways of measuring comparative maintenance; by use of the monetary standard, and by use of the physical standard. The monetary standard would be accurate enough in a period of stable prices and wages, but where both wages and price levels have been changing rapidly, as in the past two years, it is of little service without the application of a corrective factor. The physical standard, that is, the number of ties and rails laid, units of equipment replaced, etc., is more nearly accurate, but it is more difficult to set up and maintain a statistical record of these factors than of those involving money. The alternative is to utilize both standards, and apply to both such elements of judgment and correction as may be possible.

As to the monetary standard, the following table shows the total maintenance expenditures of railways of Class I for the test period (annual average, years 1915 to 1917), and for the years 1918, 1919 and 1920 The figures for 1920 are necessarily estimated in part, as the table was prepared before the close of the year:

So far as the monetary standard goes, maintenance expenditures have kept even with other railway operating expenses, the ratio of maintenance to the total rising slowly from 42.4 per cent in the test period to 45.4 per cent in 1920. This does not, however, tell the whole story. If it did, the figures would settle the question of maintenance during federal control without further discussion, for the ratio of maintenance to total expense was higher in 1918 and 1919 than during the test period. Yet the physical condition of the railway plant was not so good at the end as at the beginning of federal control. Again, maintenance in

EXPENDITURES FOR MAINTENANCE, 1915-1920

	Amount	Per Cent of Total Expense
Maintenance of Way		
Test period	$407,111,000	17 7
1918	649,597,000	16 4
1919	778,105,000	17 6
1920	1,050,000,000	18 3
Maintenance of Equipment		
Test period	$567,665,000	24 7
1918	1,100,708,000	27 7
1919	1,232,702,000	27 9
1920	1,560,000,000	27 1
Total Maintenance		
Test period	$974,776,000	42 4
1918	1,750,305,000	44 1
1919	2,010,807,000	45 5
1920	2,610,000,000	45 4

1920 represented virtually the same ratio of total expense as in 1919, and the actual money expenditures were $600,000,000 greater than in 1919, yet we shall see that even this large addition to maintenance expenditures did not enable the railways wholly to make up the deficiency of the years of war-time exigency.

The question is not how much was spent, but what physical results were accomplished with the money expended. It is difficult to reach a categorical reply, because the records to date have not been summarized in full. We find it necessary, therefore, to approximate the situation as nearly as may be.

In normal years the railways lay about 100,000,000 crossties in their tracks, nearly 2,000,000 tons of steel rail, and approximately 20,000,000 cu.yd. of ballast of all kinds. The record of the Railroad Administration in 1918 and 1919 was below normal. [See article on this subject in *Engineering News-Record*, Jan. 1, 1920, page 12, and also discussion by T. DeWitt Cuyler in this issue.—*Editor.*] Statistics are not yet in hand regarding physical maintenance in 1920, either with respect to ties or rail, or ballast, or other physical elements of maintenance of way, such as bridge repairs, painting, and the like, but the railways made earnest efforts during the summer and fall to put their roadway and structures into good shape. That they succeeded, to a considerable degree, is evidenced by their ability to handle a record-breaking traffic without any such serious accidents or delays as would have resulted from weakened bridges, rotten ties, loosened or worn-out rail, uneven or insufficient ballasting. It seems safe to say, therefore, that the general condition of railroad roadway and structures was better at the close of the year than at the beginning, and on some of the railways very much better.

As to maintenance of equipment, the question is somewhat more complicated. In the first place, consideration of equipment maintenance falls naturally under two heads: Repairs, and replacements. In the second place, the railways on reassuming control of their own properties found their freight cars badly scattered, and a part of their efforts during the past ten months has been to relocate cars on home (that is, owning railway's) lines, so that proper repairs could be made in shops equipped to handle the particular types repre-

sented by home cars. This campaign has been progressing, and the situation at the end of the year was much improved over that at the beginning, yet conditions are not back to normal, and much remains to be done in 1921. In the third place, the very fact that traffic demands were so heavy in the summer and fall months forced the railways to press every locomotive and car into service, and their program of repairs could not be so extensive as a lesser traffic would have permitted. Heavy traffic conditions tend to slow up all maintenance work, of course, but especially so with regard to equipment repairs, where the necessities of the occasion virtually force railway managements to get along with minor repairs, postponing the inevitable heavy repairs to a later time, when traffic shall have become less heavy. Even with this drawback, we shall see that considerable progress was made in 1920.

Taking up these points in greater detail, we may first consider the matter of equipment repairs and replacements. As to repairs during the period of federal control, returns are available for about five-sixths of the railway mileage of Class I. From these roads the Railroad Administration took over 6,081 locomotives and 90,301 freight cars in bad order; when it retired from control, turned over to the same railways 8,111 locomotives and 119,231 freight cars in bad order —a larger number in both cases. Between March 1 and the latest date in 1920 for which figures are available at the present writing, the percentage of locomotives in bad order for all railways of Class I, has been reduced, while the percentage of freight cars in bad order has slightly increased. Roughly speaking, the condition of equipment as to bad order remained about stationary through the year 1920, although a large number of locomotives and cars were put into shape for active service, and the general condition of all equipment was improved.

Replacement Statistics

When we come to replacements, a new element enters the situation. In purchasing new equipment, no distinction is made between locomotives and cars that replace retirements of existing equipment caused by fire, wreck, obsolescence, or ordinary wear and tear, and those that represent new additions. As a matter of fact, there is a continual input of new equipment, and an outgo of old equipment, and it is proper to balance one against the other and regard only the excess of new equipment over retirements as additions, the remainder to be regarded as replacements. For example, if a railway in 1920 retired 600 freight cars from service and purchased 1,000 new cars, 600 of the new cars may be considered replacements and 400 additions. This is not the way the accounting officer handles it, nor is it the way his "retirements" account is maintained, but I am speaking rather from the general or economic point of view.

It follows that in discussing maintenance of equipment, the distinction between replacements and additions must be recognized. During the ten-year period ending with 1917 railways of Class I purchased or built 2,776 locomotives annually, and retired 1,545. Of the 2,776 locomotives, therefore, 1,545 may be regarded as normal replacements and the remainder, or 1,231, as normal additions. As to freight cars, the normal annual purchases during the same period were 126,857, and replacements 75,064, leaving 51,793 as additions.

During federal control (1918-19) the number of locomotives added annually was 2,115, of which 972 were replacements and 1,143 were additions. The number of freight cars added annually was 54,777, of which 47,762 were replacements and 7,015 were additions. It will be noticed that replacements were much below normal for both locomotives and freight cars, while additions were also less than normal, especially as to freight cars.

Statistics are not now available as to equipment retirements during 1920, although many cars—the figure is in the thousands—were retired for reconstruction. The number of new locomotives and cars delivered in 1920 was much below the average for 1918-19, principally because the Railroad Administration left few unfilled orders when it ceased active operations on March 1. Speaking generally, then, there were no additions to equipment in 1920, and not enough replacements to cover retirements, and the railways were forced to make up the lack of equipment by increasing the efficiency with which each available unit was operated, which they did with signal success. In fact, the Interstate Commerce Commission, in their annual report to Congress, pointed out that the increased average mileage per car per day and the increased loading per car in 1920 had the effect of releasing several hundred thousand cars which otherwise would not have been available.

Difficulties Encountered

The failure to provide adequate replacements in 1918 and 1919 threw an extra burden on the railways in 1920, in that they found many cars unfit for the type of transportation for which designed, and were obliged either to divert them to other uses or to retire them altogether from service. As stated, the railways have retired many locomotives and cars during the past ten months, and in addition have withdrawn thousands for complete reconstruction in their own shops or in outside contract shops. They have also shopped many cars and locomotives for lesser repairs, which is one of the reasons why the percentage of cars in bad order, i.e., withdrawn temporarily from service for shopping, remained high throughout the year 1920.

The second complicating factor referred to above is the necessity the railways found themselves under in 1920 to relocate freight cars on their home lines. At the beginning of federal control the percentage of home cars on line was 44 per cent; at the end of federal control, it had dropped to 21.9 per cent. During the ten months succeeding March 1 the railways made vigorous efforts to unscramble the situation and relocate cars on their home or owner lines, with the result that by Dec. 1 the percentage had risen to 35.5 per cent. Although still below normal, the railways are making every effort to further increase the percentage. The bearing of this situation on the matter of maintenance is that the scattered conditions of the freight cars in 1920, a condition inherited by the railways from the Railroad Administration, made it difficult to supply proper maintenance measures to cars as promptly and effectively as would have been possible had the percentage of home cars on line been greater.

The third difficulty mentioned above was the heavy traffic of 1920, which made it impracticable to withdraw locomotives and cars from service for repairs, without affecting the results of the campaign for "more trans-

portation" which the railways had launched. Especially was this difficulty apparent during the early summer, when cars by the hundred thousand were tied up at points of congestion, neither able to move nor to be withdrawn from service for shopping. As the congestion was gradually reduced, however, and the car shortage (i.e., unsupplied demands of shippers for freight cars) became less and less a factor in the situation, the railways found it possible to withdraw more of their equipment for shopping than during the congestion period, which is another reason for the relatively high percentage of "bad order," regardless of its physical condition, until it is actually taken out of service and put into the shop, or held awaiting shop, so that the percentage of "bad order" cars is governed not so much by physical condition as by the repair policy which the railways find it possible or necessary to adopt.

Unfortunately, the railways met another difficulty in November and December, just as their traffic was slackening to the point of releasing many locomotives and cars to the repair shops. This was the failure of net earnings to average anything like the six per cent contemplated by the Transportation Act. The rate earned in September, reduced to an annual basis, was 4.1 per cent, and in October 4.6 per cent, and with the possibility of lower earnings staring them in the face for November and December, many railways found themselves forced to adopt a policy of retrenchment, which of course had its effect on maintenance.

SUMMARY

Summarizing the maintenance results for 1920, we find that the record is not yet fully written, nor will it be till 1921 is several months gone. But there is enough of a record spread before us now to indicate the outstanding features of the year: namely, that the railways received from the government on March 1 a somewhat impaired plant; that they encountered numerous difficulties in their effort to make up the maintenance deficiency and keep even with current wear and tear; that they expended considerably more money than did the government, representing a slightly larger proportion of total expenses, on maintenance; that the amount of work put into maintenance, measured in material and labor, was undoubtedly greater than during federal control, and probably greater than during the normal test period, but did not fully make up the ground lost during government control; finally, that the plant and equipment at the close of the year was in better condition than at the beginning, and this in spite of the heavy traffic forced upon the railway plant during the year. In brief, the railways made a good start in 1920; the success of their efficiency campaign made it possible to do more business with fewer facilities, and thus in part to neutralize the impairment of plant; it is their hope to take a still longer step in 1921 along the path of effective and adequate maintenance of their properties

Salary Scale Approved by 13 Societies

In its first report, dated Dec. 6, Engineering Council's committee on classification and compensation of engineers (Arthur S. Tuttle, chairman) reports that 13 societies have endorsed the classification recommended in the committee's previous report and reprinted in the issue of *Engineering News-Record* July 20, 1920, p. 224.

Industrial Waste Prevents Self-Purification of Water Courses

AN INDIRECT but none the less serious result of trade waste in streams, particularly those used as sewage carriers, was pointed out in a paper by Thurlow C. Nelson, assistant professor of zoology at Rutgers College, presented at the recent convention of the American Public Health Association.

"For five years," Mr. Nelson stated, "practically no oyster larvæ have advanced beyond the embryonic stage in New England waters. The industry there is facing total extinction. All scientific and practical testimony is united in attributing the chief cause of failure to the great outpouring of industrial waste incident to the war. New Jersey, Delaware and Maryland, with oyster grounds further removed from industrial centers, have thus far suffered less. The end is inevitable: let present conditions continue and in ten years the oyster will be only a memory.

"If the oyster alone were concerned, we could afford to lose it in view of the value of our industries and their products. However, the industrial wastes which have killed the oyster larvæ have at the same time destroyed the biological machine which normally takes care of the self-purification of these bodies of water. The stream which a short time ago cared for large volumes of sewage can now no longer do so and one finds the banks strewn with heaps of putrid fecal matter. During the warm months these accumulated masses swarm with flies, addiding to the danger of the situation.

"Pollution has passed far below its former bounds and is now invading the bathing beaches and shell-fish bearing areas which a few years ago were miles from any source of contamination. Evidence from all sources shows that pollution is progressing rapidly down nearly all of our large streams. There can be put one result—in ten or fifteen years the greater part of the eastern United States will be cradled in a septic tank."

Drainage Development in the Southeast

Drainage in the nine southeastern states dates back only to 1909, when the North Carolina law was enacted, as prior to that time none of these states had workable drainage laws. All of them now have laws which provide for the acquisition, financing and construction of improvements by drainage districts, although in two states the legal difficulties have only recently been cleared away. A paper by S. H. McCrory, chief of drainage investigations, U. S. Department of Agriculture, which was read at the recent meeting of the National Drainage Congress, shows that these nine states in 1909 had 46,571,000 acres of swamps and overflowed land, of which about 5,000,000 acres are now being drained, at a cost of about $28,523,000. This area includes 2,000,000 acres of improved farm land and 1,846,000 acres of timber or cutover land, the remainder being unimproved land. Financing by district bonds is the usual method, Florida being the only southeastern state to undertake drainage of agricultural lands. According to Mr. McCrory, the value of drainage bonds is now more generally appreciated by investors and in some states such bonds are legal instruments for school funds and savings banks. It is important that this reputation should be guarded carefully and that projects of questionable merit should not be undertaken.

Pending Railroad Construction Generally Confined to Current Transportation Needs

EFFORTS were made to secure for publication the pending construction programs of twenty large systems. Outlines of those of five big systems are here published, which indicate a considerable volume of improvement work, but which should be considered as the plans of large companies prepared far in advance. Seven other large systems, at the time of writing, had not yet determined their construction plans for 1921 in such form as to warrant statements—in most cases ascribed to the uncertain situation following the recent falling off of traffic. No indication of the situation on eight other large lines has become available.—EDITOR.

RAILROAD CONSTRUCTION for 1921 will be largely confined to the more immediate necessities of additional transportation and will not extend to large programs for improvements and extensions which were thought likely early last fall with the increase in rates and a very large volume of business, according to information received from twelve of the larger carriers and statements made by Interstate Commerce Commissioners and the Association of Railway Executives. While some of the carriers have already formulated fairly large programs for improvements in 1921, it is indicated by replies received from representative companies that work generally will be confined to more immediate and pressing needs due to the change in the business situation and consequent falling off of traffic.

Some of the principal improvements planned to complete or begin this year are: The Castleton Bridge over the Hudson River, New York Central R.R.; new coal pier at Baltimore, Western Maryland R. R.; new coal traffic facilities, Norfolk & Western Ry.; Claremont piers and deep water terminal, New York Harbor, Lehigh Valley R.R.; double-tracking on Virginian Ry.; double tracking Big Four R.R.; three large freight yards, New York, New Haven & Hartford R. R.; trestle filling, tunnel improvement, ballasting, and heavier rail, Southern Pacific Co.; elimination of limiting tunnel, Delaware & Hudson Co.; yard reconstruction at Baltimore and new bridge crossing Big Miami River at Lawrenceburg, Ind., Baltimore & Ohio R.R.; line revision, Norfolk Southern R. R.; enlargement of yards and engine facilities, Texas & Pacific Ry. and Wheeling & Lake Erie Ry. These improvements represent some of the larger work that has been in contemplation for some time, but the large bulk of improvement work now definitely or tentatively planned for the coming year is in extension of tracks, yards, freight-handling facilities, new ballasting and heavier rail to provide for immediate transportation necessities and to renew old plants.

Outlines of the construction program of five large systems follow:

Southern Pacific Co.

Pacific System

IN ADDITION to trestle filling and tunnel improvement work the Pacific System of the Southern Pacific Co. has adopted an extensive program of ballasting and laying of heavier rail. The entire program involves generous expenditures for ordinary maintenance and for additions and betterments to provide for the more expeditious handling of existing and prospective traffic.

The maintenance program includes bank widening, ditching, tie renewals, rail renewals and ballasting—particularly relaying rails. Authority has been given to relay 450 miles of track with new 90-lb. rail; 2,000 tons of maganese rail will be laid on sharp curves over the Tehachapi, Siskiyou and Sierra Nevada Mountains. Branch lines and sidings are being relaid with 75-lb. and 80-lb. second-hand rail. The ultimate intention is to have nothing less than this weight of rail in such tracks.

BALLASTING PROGRAM

Ballasting with crushed rock, slag and gravel is under way on various parts of the line, 130 miles of crushed rock and 90 miles of slag ballast having just been completed, with 220 miles of slag ballast to be placed. Gravel ballast is being used in reinforcing and in ballasting branch lines. On the ballasting from Niland to Araz Junction via Calexico, a distance of 96 miles, 28 miles have already been completed. From Stockton to Merced (Oakdale Branch) 72 miles, ballasting is nearing completion; 1921 program under way contemplates application of 650,000 yards during the year.

Additional trackage and yard improvements are being made at Ogden, Utah; Wells, Nev.; Carlin, Nev.; Sparks, Nev.; Bayshore Shops, San Francisco; San Jose, Cal.; Los Angeles; Yuma, Ariz.; Tucson, Ariz.; Bakersfield, Cal.

Attention has been given to the subject of freight house improvements. At San Francisco, for example, the company is constructing a 6-story reinforced concrete terminal warehouse and trackage, connecting rail with water. Existing facilities are being improved at East Portland, Ore.; Walnut Grove, Cal.; Nogales, Ariz. Freight house extensions are being made at the following places: Fruitvale, Brawley, El Centro, Calexico, Patterson, Weed, San Luis Obispo, Vacaville, Cordelia, Orland, Modesto, Gustine. Improvements in freight handling methods are being undertaken wherever required. For use at San Francisco a 30-ton Gantry crane, with 400-ft. runway, will be installed to facilitate unloading heavy freight from gondola cars.

Engine terminal improvements in the form of reinforced concrete rectangular engine houses are being constructed at Tracy, Mojave and Indio; 100-ft. turntables have been installed at Tucson and Yuma, Ariz., and Dunsmuir, Cal., replacing 80-ft. turntables and permitting the operation of heavier power.

At Sacramento the company has recently completed an electric furnace and steel foundry and a brass foundry. Authority has been granted for the following additions: At Sacramento a spring shop, planing mill, 2-story general store building, reinforced concrete building for oil and paint storage; at Oakland, Cal., a laundry building; at San Francisco, Bayshore Shops, an emergency hospital, dry lumber shed, boiler shop; at Los Angeles a concrete oil house; at Tucson, Ariz., boiler and tank shop. A two-story building at Portland, Ore., is being remodeled for use as up-town ticket office and waiting room for electric lines.

TRESTLE FILLING—TUNNEL IMPROVEMENT

An extensive program of trestle filling is being followed. At Albany, Ore., over Willamette River, a swing bridge and two approach spans of steel construction with concrete piers, will replace wooden Howe truss. Three miles of deck of the Salt Lake trestle is being rebuilt as part of plan to rebuild deck of entire 12 miles of this trestle within four years.

Separation of grades at state highway crossings is underway at Red Bluff, Pittsburgh, Guadalupe, Cal.; Ashland and Tolo, Ore.

On line over the Tehachapi, tunnels are being enlarged to standard section and timber lining replaced with concrete. This work is proceeding on a progressive plan

Length of the 18 tunnels on this line aggregate 8,200 ft., of which 4,100 ft. have been enlarged and concreted; line change will get rid of two tunnels aggregating 1,200 ft.

To expedite movement of trains, passing sidings are being extended and new ones constructed at many points on the system, aggregating 74,000 ft.

Three freight piers are being completed at Oakland Pier to handle transpacific and coastwise business. This is first unit of waterfront development plan.

At Port Costa, Benicia, Vallejo Junction and South Vallejo, complete renewal of the docks and wharves with creosoted timber is under way because of recent appearance of the teredo in the waters of Carquinez Straits following a period of drought.

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Lines in Texas and Louisiana

IMPROVEMENTS and extensions on the Southern Pacific Lines in Texas and Louisiana that will tend to increase transportation capacity include an extensive program of ballasting and relaying of heavier rail; bridge renewals for use with heavier power; a belt line at Dallas, Tex., and additional running track and line improvement at El Paso, Tex.

Work is now under way gravel ballasting 42 miles of track from Kaufman to Dallas, Tex., and preparations are being made to ballast 245 miles of main line and passing tracks with burnt clay between Kaufman and Voth, Tex., to permit increase in average freight train speed. Burnt clay will also be used for ballasting 213 miles of main line and passing tracks between Humble, Tex., and Shreveport, La, and 52 miles on the Fort Worth branch.

Heavier rail is being laid on some 290 miles of track—90 lb. replacing 80 lb. and 80 lb. replacing 60 lb.

Work is now 50 per cent complete in adding over 6 miles of track to the Englewood yard at Houston, Tex., and constructing 1½ miles of second track on freight cut-off from Galveston division main line at Baer Junction to Englewood yard. Construction of 9 miles of belt line at Dallas, Tex., to permit routing of through business without passing through city terminal, to facilitate interchange, is about 50 per cent complete and construction of 2½ miles of second-line track on primary main line from Union Depot, El Paso, to the Rio Grande River, together with line improvement, is nearing completion.

At Hearne, Tex., additional tracks and facilities will be constructed for light-car repair work. New 150-ton track scales at four points are being built to facilitate car movement with proper billing.

At Beaumont and Liberty, Tex., steel draw spans of 247 ft. and 225 ft. respectively will be replaced with heavier construction to permit the use of heavier power. Work on each has already been started.

A new water station with 120,000-gal. capacity concrete storage tank has been practically completed at Pecos High Bridge, Tex., and work has been started on another station with 65,000-gal. steel storage tank at Devil's River, to be completed at an early date.

New York Central Lines

IN ITS extensive improvement program of the past year and planned for the immediate future the New York Central Lines have given special attention to work giving direct and early results for increased transportation capacity to "get more cars over the lines." In addition to a program for rehabilitating rolling stock at a cost of $53,000,000, large physical improvements which will be begun this year, including the Castleton bridge over the Hudson River between Poughkeepsie and Albany to divert freight traffic and practically double the capacity of the line. Double tracking on the Big Four now under way calls for an investment of more than $3,000,000 and improvement of the Michigan Central in Detroit will cost about $1,500,000.

On the New York Central proper some $5,500,000 will be spent to relieve special situations including improved mechanical freight handling at terminals; additional yard tracks, cut-offs and sidings, mechanical coal-handling plants and miscellaneous terminal improvements. Work has practically been completed on the "subway" at Erie, Pa., at a cost of $190,000 and on the Youngstown viaduct and relocation of freight houses ($310,000). Elimination of grade crossings at Rochester, N. Y., at a cost of $650,000 is under way. At Rensselaer, N. Y., a coaling plant with ash pit and sand house is nearing completion ($365,000). In the electrified zone $880,000 will be spent for new electrical generating unit at Port Morris, N. Y., and a new 11,000-volt circuit to the 50th St. Station, New York City.

At Elyria, Ohio, $350,000 is being expended in grade-crossing elimination work at six points, and a subway at Wesleyville, Pa., is being built at a cost of $230,000. Additional yard tracks and a 200-ft. submerged cinder pit are being installed at Collinwood, Ohio ($110,000). Stock feeding and resting pens with new trackage at a cost of nearly half a million is nearing completion at Rockport, Ohio. At Detroit the renewal of the River Rouge drawbridge is practically complete at a cost of $270,000 and for raised tracks and subways work is started at three streets at an estimated cost of over $100,000.

Double Tracking on Big Four—Michigan Central

On the Big Four double-tracking work is under energetic headway on points between Lamb, Ohio, to Ansonia, Columbus to Arvenue, Briar to Beach Grove, Augusta to Whitestone, Winchester to Faunland, Templeton to Swanington, etc. Attention also will be given to the needs for new passing tracks and sidings to permit longer trains and to facilitate dispatching. Additional terminal facilities at various points, including engine terminal improvements, are under construction at an estimated cost of $1,500,000. Second track, relocation and bridges, Augusta to Whitestone, at a cost of $1,160,000 are more than half completed. Yard extension at Mattoon, Ill., and a new freight house at Muncie, Ind., will cost $250,000.

On the Michigan Central attention is being directed to the need of additional passing tracks and the enlargement of existing short sidings on the Canada divisions. Yard and storage tracks also are to be extended. These projects total ultimate expenditure of over $600,000.

The reconstruction of the River Rouge bridge at Detroit is now almost completed. The separation of eleven grade crossings, under agreement with the city of Detroit for joint expense, is well advanced.

Boston & Albany—Pittsburgh & Lake Erie

Drawbridges at Chelsea, Mass., and a new bridge at Westfield, Mass., have been almost completed at a cost of $530,000. The Pittsburgh & Lake Erie has completed enlargement of the Hazelton, Pa., yard at a cost of $175,000.

For additional coal-handling facilities, involving the extension of sidings, the Toledo & Ohio Central will spend over $200,000 and the Zanesville & Western and the Kanawha & Michigan, for similar traffic, will expend $300,000 on enlarged yards and engine terminals, together with one line revision to eliminate "pusher" service. For additional sidings and mechanical repair facilities the Cincinnati Northern will spend $100,000, and for betterment of terminals and sidings the Lake Erie & Western will spend about $250,000.

About half a million dollars will be expended by the Indiana Harbor Belt R.R. for additional terminal and freight-handling facilities. In this connection the New York Central has submitted to the Interstate Commerce Commission for its approval a project for the development of Chicago terminal freight service involving the lease, operation and ultimate purchase of the Chicago Junction Railway Company's terminal property, the inner belt line connecting with the Indiana Harbor outer belt line. The purchase price is set at $33,000,000.

The Rutland (Vt.) R.R. will spend about $60,000 to increase clearances.

Large work on the New York Central that is planned for the near future, but for which definite time of commencement has not been determined includes Cleveland Union Station, Buffalo terminal improvement, West Side Manhattan improvement, New York City (considered by the

railroad as inevitable at some future date), Cincinnati terminal improvement, Weehawken, N. J., water-front development, Albany, N. Y., station, additional grade and yard separation at Indianapolis, and a very large program of double-tracking and extension of yards and terminals at many points on the system.

Norfolk & Western Railway Co.

A COAL branch line of 18 miles at a cost of $2,000,000 and additional coal pier facilities at Norfolk at a cost of $800,000 are the principal improvements under way on the Norfolk & Western Ry. At Roanoke, Va., a new water supply is 75 per cent completed that will cost $223,000 and new engine-terminal construction will cost $1,000,000. Additional terminal and yard facilities at two points are being built at a cost of $1,510,000 and a tie-treating plant at Radford, Va., is being constructed at a cost of $500,000.

New Facilities for Growing Coal Traffic

The coal branch line on Pigeon Creek and Rockhouse Fork—a distance of 18 miles—is 60 per cent completed. A new 120-ton capacity car dumper is being constructed at Norfolk, Va., capable of dumping cars containing 120 tons of coal, with a total maximum length of 60 ft., and in addition present piers Nos. 2 and 3 are being electrified. The work will cost $650,000 and is 30 per cent completed. A trimming machine is being designed for application to pier No. 4 at an estimated cost of $150,000, and it is expected that the installation will be completed during the year.

At Bristol, Va., additional yard tracks and engine terminal facilities are nearing completion at a cost of $1,300,000, and at Norfolk additional yard tracks and rearrangement of tracks to expedite switching and dispatch of coal are 30 per cent completed, and the work will cost $210,000. Additional engine-terminal facilities at Roanoke, Va., including a forty-stall roundhouse, machine shop, power plant and several minor structures, are nearing completion at a cost of $1,000,000.

The water supply being constructed at Roanoke is 75 per cent complete and will have a 2,000,000-gal. reservoir and a pumping capacity of 6,000,000 gal. per day. The tie-treating plant at Radford, Va., will have a capacity of 1,000,000 ties yearly and is 50 per cent completed.

On the main line between Bluefield and Norton work is 75 per cent completed extending six passing tracks at a cost of $150,000. At Columbus, Ohio, work is nearing completion on a bridge to carry a freight-house spur across Pennsylvania R.R. yards at Cleveland Ave. at an estimated cost of $140,000.

No additional second or third track has been constructed along the main line. About 3 miles of unimportant branch-line track has been abandoned and taken up.

Erie Railroad Co.

IMPROVEMENTS now under way on the Erie R.R., in addition to rehabilitation and purchase of rolling stock, are estimated to cost approximately $1,200,000 and work contemplated in the near future, $1,400,000.

Work now under way includes: A freight house at Newark, N. J., for handling fruit business, capacity twenty cars, to relieve congestion at New York; new drawbridge at Newark to replace wornout structure; placing signal and telephone wires underground at Passaic, N. J.; replacing 70-ft. turntable with 100-ft. turntable to accommodate larger engines at Susquehanna, Pa.; shop improvements, additional roundhouse tracks, coaling plant improvement, including steaming devices to prevent freezing, a bridge over the Canisteo River for access to shops, and remodeling of purchased building for Regional offices at Hornell, N. Y.; remodeling passenger station and coaling plant improvements, including steaming apparatus, at Buffalo; coaling plant improvements and steaming apparatus at Salamanca, N. Y.; purchase of property for extension of railroad slag dump at Phalanx, Ohio; rebuilding coal crusher plant at Kent, Ohio; extending stalls in roundhouse to accommodate larger power, and extending ash-pit facilities at Marion, Ohio; rebuilding freight station at North Tonawanda, N. Y., and building storage tracks in the vicinity of Youngstown, Ohio.

Work contemplated for the near future includes second track at Akron, Ohio; new main track to provide switching facilities and car storage yard at Warren, Ohio; engine standing track facilities and additional yard track at Salamanca, N. Y.; additional tracks in west-bound yard, Meadville, Pa.; rearrangement, west-bound engine tracks, Kent, Ohio; repair shops, Kenmore, Ohio, 3 miles of double-track, Belfast, N. Y.; rearrangement of tracks to facilitate handling of ore cars, Sharpsville, Ohio; extending erecting shops, Susquehanna and Meadville, Pa., and elimination of grade crossings, Springwater and Warsaw, N. Y.

It is stated by the railroad that all expenditures have been made for the purpose of speeding up the operation of present facilities rather than for extensions, and that the plans for the immediate future are on the same basis.

Baltimore & Ohio Railroad Co.

AT THE close of Federal control the government had expended about $21,000,000 on the lines of the Baltimore & Ohio largely for yard and terminal extensions. When the railroads were returned to private management, however, some $3,000,000 was required to complete the work under way and since then the Baltimore & Ohio has arranged for further work aggregating some $5,000,000 to meet immediate requirements and to round out improvements already under way, involving a total expenditure for additions and betterments of approximately $8,000,000. The more important of these are:

Revision of a branch line and construction of yard for 400 cars at Locust Point, Baltimore, necessary for large new industrial development, at a cost of $995,000.

Completion of automatic signals between Willow Grove and Goehring, Pa., (35 miles) at a cost of $109,000.

Rebuilding of bridge across Allegheny River at Pittsburgh involving replacement of old bridge with new double-track structure capable of carrying the heaviest power and at a height of approximately 13 ft. above the old structure, at an estimted cost of $2,100,000.

Relocation of line and reconstruction of yard at Girard, Ohio, for industrial development, at a cost of $336,000.

Construction of a bridge at a new location and elevation across the Big Miami River at Lawrenceburg, Ind., at a cost of $1,980,000.

Relocation of main line and construction of roadbed for second track between North Dayton and Tippecanoe, Ohio, to conform to requirements under the Miami Conservancy improvement, at a cost of $475,000.

Miscellaneous expenditures incident to extensive program of bridge renewals, elimination of grade crossing of the National Pike at Claysville, Pa., etc., $2,045,000.

With the completion of improvements now under way the railroad company considers the property generally in well-balanced relation, with no immediately pressing requirements, but traffic is constantly developing and if it so continues, as expected, the company intends to perfect plans for handling such additional business through the enlargement of its divisional yards, the construction of additional main tracks through the more congested territories, and such other betterments as are necessary to meet the requirements as they develop.

Since the period of Federal control the Baltimore & Ohio has ordered new equipment, now being delivered, and has rehabilitated existing rolling stock, at a total cost of about $11,000,000.

Steel Shipbuilding in the United States

According to a summary prepared by the Bureau of Navigation of the U. S. Commerce Department, 334 steel vessels were building or under contract in private American shipyards on Nov. 1. Their total capacity is 1,206,486 gross tons, or something less than 4,000 tons average per ship.

Letters to the Editor

Water Important in Concrete Surface Conditions

Sir—Your editorial, "Unsightly Concrete Surfaces," in the issue of Dec. 16, 1920, p. 1161, states the problem so clearly that its answer is almost obvious. It is astonishing that there appears to be among engineers generally so little realization of the importance of producing concrete construction "of permanently good appearance," consequently so general a failure to grasp the cause of unsightly concrete.

Efflorescence or bloom, "characteristic patches and streaks of discoloration," surface cracking and checking, spalling and the many other surface ills which are responsible for the "distressing appearance" of so much concrete construction have a single underlying cause. The presence of water in the concrete, either through the natural absorption of rain and atmospheric moisture into the surface, or, and more serious and important, the percolation of water through the concrete to the exposed face.

The action of moisture is, in the main, three-fold: first, the dissolving of the soluble magnesium and calcium salts in the concrete and carrying them to and depositing them on the surface as efflorescence or bloom; second, by creating differential expansion—the expansion of concrete due to varying moisture content being considerably greater than that due to temperature changes—it starts cracks parallel to the surface at approximately the average depth of penetration of the moisture with resulting spalling; third, by sudden expansion on freezing it creates additional cracks and completes the work of deterioration already started.

On concrete building construction and most vertical concrete surfaces above grade it is a question simply of preventing the surface penetration of water. It must be admitted here that as far as the writer knows none of the methods at present generally in use are entirely satisfactory but it is felt that by the use of the right type of paint or colorless penetrative waterproofing application with particular attention given to the back of parapets and copings, quite efficient results can be obtained. The writer has observed instances where such handling of the problem has produced most satisfactory results for periods of from ten to twelve years.

On retaining walls and particularly on concrete bridge construction the problem is chiefly one of percolation of water through the concrete and is more serious and difficult. Its successful solution at the initial attempt is more vital. Here it is strictly a pressure waterproofing problem; to be solved, however, as the particular conditions demand. The point of real importance is that the need of real waterproofing efficiency and the need of producing this efficiency at the first try be generally recognized. In the writer's experience he has observed two essential characteristics beside waterproofness which a waterproofing system for this work should possess—a proved, effective life equal to that of the structure; elasticity under all conditions and variations in temperature.

In conclusion the writer seriously doubts if in concrete construction "there is any prospect of being able to make exposed surfaces of permanently good appearance without finishing treatment" or at least effective protection against water percolation. He believes, however, that "concrete construction that can honestly show its own face" will be produced when it is generally recognized that water is its worst enemy and must be thoroughly and efficiently guarded against.

ALLRICH S. HARRISON.

New York, Dec. 28, 1920.

Highway Situation Pictured as Seething Mass of Flux

Sir—Under date of Nov. 11, 1920, on the front cover of *Engineering News-Record*, you say: "The past year has been one of unusual confusion in the highway field."

This statement seems to be not only true (please do not infer that I think truthfulness rare in the *News-Record*) regarding the material shortage conditions to which you applied it, but also to the general and specific conditions covering practically the whole highway field. During the past year, from Dec 20, 1919, to Dec. 16, 1920, inclusive, the *News-Record* has published about 120 articles (45 of which were contributed) covering the "field" from administration to physical work, from research to finished product and from reconnaissance to maintenance.

Surely "the world do move." It is not over ten years ago that one of the then most widely known civil engineers in New York State told me that highway work was not engineering, but psychology. This man's statement was made from a knowledge gained as an executive officer of a large and growing state highway department—therefore entitled to consideration.

Either highway work has moved or you gentlemen of the McGraw-Hill Co. are publishing a psychological magazine under a false name and thousands of highway designers and builders are carrying misleading titles. What your reasons were for publishing any, or all, of the aforementioned articles is of no concern at present. As a psychological engineer I am more interested in what they contained and what builders of roads can get out of them.

After reviewing the year's offering as set forth in these articles, would it not be justifiable to paraphrase your quoted saying: The past year has been one of unusual flux in the highway field. Would not that statement fit the field as including administration, design, construction and maintenance as your statement fits the field of material delivery and its relation to the general work of highway building?

Such a review discloses the fact that the policies of one state are tabooed by the next and that a third considers the first two wrong; that the commission in one commonwealth demands the perogative of controlling its highway inspection from the "seats of the mighty" and that in another is willing to take a chance and let some of its subordinates look after the details; that one man speaking with authority states that "clay is a fluid" and all our text and hand books have entirely overlooked this important fact.

Again we are told that ditches are a wasteful expenditure of time and money and a detriment to an improved highway. Then we learn that ditches are better than tile (must we infer that ditches and tile are both of no value?) and next it is stated that ditches are so ingrained in the road fabric of the British Isles and the Continent that they cannot be separated therefrom.

Then we learn how much we should be paid, and "the great unrest" is intensified; next, that an important state is maintaining its roads by the use of clean screened gravel, unbound, and for years some of us have been attempting to obliterate the unbound spots from our roads; that a certain policy has just been inaugurated, but we know it was inaugurated at least four years ago; that a billion dollars has been made possible for highway work, but we realize this can be meant only as a small beginning when we multiply the cost per mile spent by some authorities by the number of miles needing improvement.

What have we learned, or what can we learn from these articles?

I have learned that the highway field covers the greatest construction program in the United States today; that its ideas and ideals are in a state of flux boiling and seething at a white heat; that the curent literature on the subject runs the gamut from grave to gay and from sense to nonsense; that every place has its own particular problems as well as many general policies which it must follow and obey and that the experience of any other locality or the theories of any other persor can be used only in so far as they fit my particular conditions; that inexperienced men are formulating policies and propounding theories which cover as much typewritten space as those of experienced men.

If my primary object is to get my people out of the mud—if that is what

they demand—then the order to myself, as I review the *News-Record*, is: As you were! The final conclusion is, stay steady—there are enough others rocking the boat to prevent the trip from becoming monotonous. Because some fellow is building a Belgian block, reinforced-base pavement 30 or 40 ft. wide is no reason why I should be discouraged because I cannot do likewise. Neither shall I despise the fellow who is building gravel with H_2O for binder (maybe he is doing the best thing possible). Because the policy in Maine or Iowa differs from that in New York is not proof that the latter is wrong.

Centrifugal force, capillary attraction, the flow of water—these and other laws are the same adjacent to an improved highway as in other localities. Stay steady.

Would it not be interesting to you of the staff to learn how a review of the *News-Record's* offerings during the year just passed has influenced others who are engaged in this great, new-old line of work?

Wishing you a very hapy and a prosperous New Year I remain,

T. M. RIPLEY,
Division Engineer, New York State Highway Department.
Watertown, N. Y., Dec. 30, 1920.

Useful Dodges in Surveying

Sir—In your issue of Dec. 16, 1920, p 1164, there is described by H. L. Thackwell a method of surveying by means of transit and stadia with the aid of a sketch board. This method was used by the writer about fourteen years ago in the location surveys for the Catskill aqueduct. Considering the surveying apparatus which was available at that time this furnished a very satisfactory method, although at the close of the work a single plane-table party was beginning to turn out better work at a lower cost than any of the transit parties.

Since that time the great improvements both in plane-table apparatus and in methods have so increased its superiority over transit and stadia methods that it seems strange to the writer that anyone should advocate the use of the latter for a topographical survey of any description, much less one involving a considerable area. The application to the plane-table alidade of the Beaman attachment makes it possible to read distance and elevation direct without the use of the slide rule, thus dispensing with any computations and making the process purely mechanical. Since with the plane table the location of the points is also mechanical, the speed is greatly increased and the probability of error is greatly reduced. It is possible to close traverses over considerable areas with the plane table and control is necessary only when the area becomes of some magnitude. In the writer's opinion the use of transit and stadia methods is justified only where plane-table apparatus is not available and where the size of the work will not justify its purchase.

In military work the plane table has supplanted the transit both for topographical surveys and for the problems of battery location. In civilian work we find the U. S. Geological Survey the greatest mapping agency in the world using nothing else.

If the duration of the survey is to be greater than six weeks it is the writer's opinion that the plane table will not only pay for itself but the results obtained will be very much better.

JOHN P. HOGAN,
New York Water Power Investigation.
New York City, Dec. 27, 1920.

Favors Higher Auto Tax

Sir—I wish to make a serious plea for a curtailment of expenditure for road building. One could very well argue for such curtailment at this time as a temporary policy since for a nation, as well as for an individual, there are times when it is advantageous to keep its assets in a liquid condition, and so one could even admit road improvement to be desirable and still consistently urge that none of it be done for awhile so as to conserve liquid assets.

But I wish now to go further and make a broader argument and insist that road improvements should not be made from funds raised by general taxation. Since the use of automobiles has become general the cost of building and maintaining roads has increased greatly. This increased cost, I maintain, should in justice be borne by motorists. And building and maintaining roads by general taxation does not place the burden there. Part of the burden falls on motorists, but an inadequate part.

To make this argument quantitative let us say that the cost of a road for a traffic of 500 automobiles daily is $20,000 per mile and that annual maintenance would be $500 a mile. Then with interest at 5 per cent the annual cost per mile of road would be $1,500 and the daily cost say $5, so that 1c. per mile would be the road expense for each automobile. If each automobile is run 5,000 miles in a year the charge against it to maintain the road should be $50 annually but no such tax is levied, the usual annual fee being $10, in some cases $5, so that the automobile owner pays only about one-fifth what he should.

But it may be said in answer to any such argument that the general prosperity throughout the country brought about by the use of automobiles is such that general taxation for road building purposes is amply justified. The recent severe decline in prices and resulting business depression has furnished a means of testing such an argument. Iowa is the state having most automobiles in proportion to population. The people of this state borrowed this fall from the Federal Reserve Bank of the Seventh District 245 per cent of its quota of the usual crop moving loans, while Illinois took only 84 per cent, Michigan 102 per cent and Indiana 86 per cent. Furthermore, South Dakota, which ranks seventh among states in regard to number of automobiles in proportion to population, is the state where banks have been failing.

A stiff tax on automobiles would benefit the United States. To hold up for awhile on road construction would also benefit.

JOHN WILKES,
Civil Engineer.
Nashville, Tenn., Dec. 27, 1920.

A Plea for Mathematical Forms

Sir—Referring to the article entitled "Simple Solution of Three Highway Construction Problems," by W. B. Walraven in *Engineering News-Record* of Dec. 16, 1920, p. 1172, the question I would ask the author is: Why should we abandon mathematical conventions when considering a problem in mathematics?

In his Problem 1 the author assumes the center of the circle at the origin of the rectangular coordinates in which case the mathematical equation of the circle is $X^2 + Y^2 = R^2$, and his axes are X and Y instead of H and V as given.

Instead of considering the center of the circle at the origin of the axes it would be more convenient, in highway curve problems, to assume that the P.C. is at the origin of the axes and that the tangent through the P.C. is the Y axis. The center of the circle would then be to the right or left of the origin and on the X axis. The arc to be considered may be in any quadrant. With this assumption the rectangular equation for the circle would be $Y = \sqrt{X(2R - X)} = n$ (in the article), and $X = R - \sqrt{(R + Y)(R - Y)} = 0$ (as given). We may then proceed along mathematical lines and determine the values of the other elements in terms of X and Y as also X or Y in terms of R, T, C, L, E, M and I or Δ.

As a second question: Why use the arbitrary idea of "degree of curve" on highway work, instead of the mathematical idea of radius of curvature? "Degree of curve" has little practical value in the location of highway curves and is an obstacle to a thorough working knowledge of the mathematics of the simple circular curve.

I find the same fault in the article by Walter H. Drane, "A Method of Setting Out Curves," appearing in the same number (p. 1176), in that the diagram of the curve is not presented as a mathematical graph. It should also be noted that $FA = 2R \sin \Delta/4$ and not as given.

This is a plea for adherence to mathematical forms and usages in the solution of practical mathematical problems.

I value these articles for the "Average Engineer," as engineering is mostly of the average variety.

JOS. A. KITTS.
Petaluma, Cal., Dec. 24, 1920.

HINTS FOR THE CONTRACTOR

Comparing Paint Costs

BY A. H. SABIN
Consulting Chemist, National Lead Co., New York

If a paint costing $3.50 a gallon lasts 5 years, what is the value of a paint which lasts 4 years?

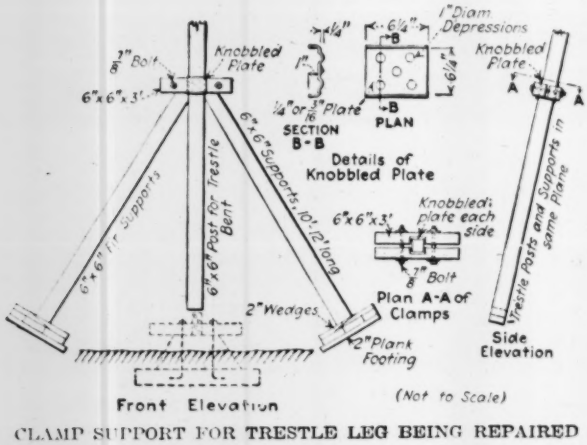
With labor at 75c. per hour it would cost $6 to apply it. Then the cost would be $9.50 applied, or $9.50/5 = $1.90 per year, = $7.60 for 4 years, per gallon of paint used. Deducting $6 for labor, the value of the 4-year paint, if it is to be on even terms with the 5-year paint, is $1.60. By similar calculation, with labor at 60c. it is $1.84; or with labor at 50c. it is $2; or with labor at 40c. it is $2.16.

If the $3.50 paint lasts 6 years, the values of the 4-year paint become 32c., 77c., $1 and $1.27. The 4-year paint would have to be given away if the $3.50 paint lasts 6¾ years on the 75-c. labor basis, or 6.9 years on the 60c. basis, or 7½ years on the 50c. basis, or 8¾ years on the 40c. basis.

Simple Support for Trestle Legs While Replacing Footings

BY DONALD G. COOMBS
Office Engineer, Braden Copper Co., Rancagua, Chile

SIMPLE supports for the legs of a high trestle, while renewing the concrete footings, are indicated by the accompanying drawings. The trestle was 1,034 ft. long and 168 ft. high over the river. Because of a land slide the piers for about twelve bents were dropped from 6 to 16 in. and moved laterally as much as 24 in. The piers were about 6 ft. square at the base and 3 to 3½ ft. high, and to remove them and sink new footings to more firm ground entailed supporting the legs of the trestle bents in a safe manner without interfering with the progress of the excavation, etc. The sketch shows the method. But one bent was worked on at a time as a matter of safety, and the clamp shown was attached just below the second row of horizontal bracing. The trestle timbers were of Douglas fir, so that when the bolts were tightened the knobs on the plates bit into the timber sufficiently to prevent slipping. By means of wedges the posts were raised the few inches necessary to level the trestle and by being placed in the same plane as the batter posts no distortion occurred. With this device two carpenters and a few laborers took out the old piers from one side of twelve bents; excavated several feet for and poured new piers, and realigned the trestle at a cost of 20 per cent of the estimate.



CLAMP SUPPORT FOR TRESTLE LEG BEING REPAIRED

The work was done under the direct supervision of Dave Dupuis, general foreman, and the clamp and method were his idea. The writer was office engineer.

The Camp Commissary

SOMETIMES we feel that the last has been said on the camp commissary—not that camp commissaries cannot be improved but that we all know how they *should* be run if even the practice is not up to the theory. Yet an old hand in watching camp commissaries sends us the following comment:

"Napoleon said that an army 'marches on its stomach,' but even with a policy that places the importance of commissary as high as that it is doubtful if one of Napoleon's best mess sergeants could hold the job of supervising commissary in a modern construction camp. In military life court martial threatens the deserter. The modern laborer indulges a temperamental disposition and on the slightest provocation is ready to draw his 'time' and move on.

"The average quality of food served in construction camps has materially improved in recent years. The experienced contractor now regards it as necessary to hire capable chefs, expensive though they are, keep them well supplied with the best materials and sell the resulting high quality food to the men below cost—below a cost figured on wholesale prices. Costs are kept down because beef often is delivered on the hoof and butchered at the camps; other supplies are bought in carload lots. Meals such as are provided in these camps, when furnished to individuals by restaurants or boarding houses, have to be sold at a price that will cover high overhead waste, due to uncertain patronage, and a profit on the cost of food bought and prepared in a more expensive way. In fact, camp fare is often very much better than what the men get when in town.

"If camp fare is not excellent the contractor suffers from a high labor turnover. He soon learns just what he cannot afford to do in kitchen economies. On the other hand, where the food is regularly kept up to a creditable standard the men readily fall into the habit of taking its good quality and low cost to them as a matter of course. They easily find other matters to grumble about. In such camps, if a considerable percentage of the men speak the same language, it might be good policy to detail one of the 'mess sergeants' to prepare and post from week to week bulletins on the variety, particular kind or amount of foodstuffs received or to be received. These bulletins could give the name of the officer in the camp authorized to receive complaints about food and could occasionally show, by comparison of cost or otherwise, the advantages offered the men.

NEWS OF THE WEEK

New York, January 6, 1921

Engineering Council Activities Transferred to New Body

Beginning Jan. 3, activities of Engineering Council and the Engineering Societies Service (employment) Bureau were transferred to the American Engineering Council, of the Federated American Engineering Societies. The American Engineering Council now has an office in Washington at the McLachlen Building, 10th and G Sts., with A. C. Oliphant as acting assistant secretary in charge. This office is available for the member societies of Engineering Council. The service bureau is being maintained in the Engineering Societies Building, 29 West 39th St., New York City, with Walter V. Brown in charge.

TEMPORARY MANAGEMENT COMMITTEE

Pending the development of a more permanent organization which may direct this activity of the American Engineering Council and which has had such a close relationship with the secretarial responsibilities of the member societies of the Federated American Engineering Societies, the secretaries of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers have been requested to act as a committee on management to conduct the service bureau until such time as a permanent organization under the American Engineering Council can be effected.

The committee on procedure of the executive board of the American Engineering Council, voting to take over the employment service, specified that the applicants should be arranged in two groups: First, "preferred," those who are members of member societies of the Federated American Engineering Societies; and, second, "ordinary," all others.

As a means of comunicating with the secretaries of the member societies of the federation, a bulletin listing positions open will be regularly issued.

The following committees of the former Engineering Council have been invited to act as committees of the American Engineering Council: Classification and Compensation of Engineers; Cooperation with American Institute of Architects; National Board for Jurisdictional Awards in Building Industry; National Service Department; New York State Government Reorganization; Patents Committee; Payment for Estimating; Russian-American Committee; Types of Government Contracts.

Engineer Made New York's Superintendent of Works

Governor Miller, the new Governor of New York, has appointed Charles L. Cadle, chief engineer of the Rochester Lines of the New York State Rys., as Superintendent of Public Works—in which capacity among other things he will have charge of the operation of the New York State Barge Canal. Prior to Nov., 1917, Mr. Cadle was electrical engineer of the Rochester Lines, Rochester, coming to Rochester from Cleveland, Ohio, where he had been for two years chairman of the Electric Railway Improvement Co. He has served as a member and also chairman of the Power Distribution Committee of the American Electric Railway Engineering Association, and has acted as chairman of the committee of the Engineering Association to confer with the Bureau of Standards on the Electrical Safety Code.

J. Waldo Smith Advises Water Board for San Francisco

When the people of San Francisco are asked to vote next February on the proposed purchase of the Spring Valley water system, as announced in the *Engineering News-Record*, Dec. 9, 1920, p. 1157, it is planned to include in the measure provision for a water board. The suggestion that such a board be formed came from J. Waldo Smith, chief engineer of the Board of Water Supply of New York City, while in San Francisco reporting on the Spring Valley Water Co. properties for the local Chamber of Commerce.

As tentatively proposed by the city attorney there would be a paid water commission of three members holding office for six years, whose duties would be to determine water rates, make collections and make all repairs and minor extensions. The board would have its own staff of engineers and would handle all repair and construction work costing less than $2,500. Larger jobs would be contracted. The construction of the Hetch Hetchy project would remain under the direction of the city engineer, but when that work is completed the board would take over its operation as well as that of the Hetch Hetchy electrical power system.

A. I. E. E. Convention

The seventh midwinter convention of the American Institute of Electrical Engineers will be held in New York City, Feb. 16-18, in the Engineering Societies' Building, 33 West 39th St.

The convention will include six technical sessions and visits of inspection.

Details of Am. Soc. C. E. Annual Meeting Announced

The sixty-eighth annual meeting of the American Society of Civil Engineers will be called to order at 10 a. m. Wednesday, Jan. 19, in the auditorium of the Engineering Societies' Building, 33 West 39th Street, New York City. The first session will be a business meeting devoted to the presentation of annual reports, election of new officers, appointment of nominating committee, reports of special committees and a discussion of proposed amendments to the constitution.

For the afternoon of Jan. 19 five excursions have been arranged in case the business meeting does not continue throughout the afternoon. In the evening the president's reception and dance will be held at Delmonico's, 44th Street and Fifth Avenue.

The morning and afternoon of Jan. 20 will be devoted to an inspection trip covering a variety of industrial activities in or near New York. Motor buses will leave the Engineering Societies Building at 9:45 a.m. sharp. At 12:30 p.m. the members and guests will be entertained at luncheon by the Metropolitan Life Insurance Co., after which there will be an address on "Human Engineering and Industrial Group Life Insurance" by Haley Fiske, president of the company. At the conclusion of this address there will be an inspection of the building, including a trip to the 650-ft. tower.

At 8:30 p.m. in the auditorium of the Engineering Societies Building there will be an address by a man of national prominence on "The Engineer, His Future and Relation to the Economic Life of America," followed by the usual informal smoker.

The committee on arrangements consists of J. P. H. Perry, chairman, Robert Ridgway, Ralph R. Rumery, George D. Snyder, and Herbert S. Crocker.

Winter Halts Efforts to Salvage Concrete Steamer "Polias"

On account of heavy winter weather the attempt to get the concrete steamer "Polias" off of the rocks at Old Cilley Ledge, near the southwestern entrance of Penobscot Bay, Me., has been abandoned, although it is announced by Aëronautical Equipment, Inc., the company to which the U. S. Shipping Board awarded the contract to salvage the vessel that hope of floating her has not been entirely abandoned. Inspection of the ship will be made in the spring and if conditions then appear as good as they were this summer the efforts to float the ship will be renewed.

Engineers to Advise on New City Charter for Nashville

The Nashville Engineering Association has appointed a committee of engineers to co-operate with attorneys who are to frame a new city charter for Nashville, Tenn. Besides W. T. Young, chairman, the committee members are: Hunter McDonald, C. S. Brown, B. H. Klyce, H. C. Hibbs, W. F. Creighton and T. L. Herbert.

Kansas Society Holds Annual Convention

Laws making the registration of engineers compulsory will be introduced in the Kansas Legislature at the coming session as a result of efforts by the Kansas Engineering Society. A legislative committee was appointed at the closing session of the society's thirteenth annual convention, which was held at Topeka, Dec. 16 and 17.

Interest in the problems confronting the profession brought out an attendance of 125 engineers. That the engineering profession is as important to the state's progress as any other was the declaration of resolutions adopted.

Chancellor E. H. Lindley, of the University of Kansas, was one of the principal speakers; his subject was "Human Engineering." P. F. Walker, dean of the school of engineering at Kansas University, explained in detail the industrial survey which is being made in the state. The survey is intended to show what community is in need of certain industries or what industry can thrive best in certain communities.

The society also voted its co-operation with the state chamber of commerce, local chambers of commerce and with the state board of health.

In addition to a report on sewage made by F. M. Veatch, the members listened to and afterward discussed reports from various other committees.

H. S. McFadden, Topeka, reported on highways; D. L. Hammond, masonry and concrete; W. E. Baldry and P. L. Brockway, on the use of paving materials; L. E. Conrad, on surveys, and C. A. Haskins, on water-works.

"Bridge Development in Kansas" was the subject of a paper read by F. W. Epps, of the State Highway Department.

Plans for organizing a Kansas section of the American Society of Civil Engineers were begun at a luncheon of the members of the national society attending the state convention. A committee appointed to perfect the organization includes Lloyd B. Smith, W. E. Baldry and L. R. Tillotson, all of Topeka.

The new officers elected were: Dean P. F. Walker, Kansas University, Lawrence, president; Lloyd B. Smith, Topeka, vice-president; J. M. Averill, Topeka, secretary; J. W. Mavity, Wellington, A. E. Noble, Norton, members state engineering council; Lloyd B. Smith, member of the American Engineering Council.

Survey of Government Departments Authorized by New Law

The Smoot-Reavis resolution providing for a survey of the executive departments of the Federal government has become a law without the signature of the President. The statutory ten-day period passed without the measure having been vetoed and it became a law automatically. An incident of the legislation was the loss of the bill in the White House offices.

Opinion is divided as to whether the President would have vetoed the measure had it been brought to his attention. A joint congressional committee will be organized under the bill. It is expected that Senator Smoot, of Utah, will head the committee. The bill provides for the employment of a representative of the committee to take charge of the immediate direction of the survey which is to be made.

Advises $18,000,000 Water-Works Extensions for Kansas City

The board of review, appointed on recommendation of George W. Fuller, of Fuller & McClintock, consulting engineers, New York City, to consider the report of the latter on needed water-works improvements for Kansas City, Mo. (*Engineering News-Record*, Oct. 28, 1920, p. 865) has made a report advising a water-works bond issue of not over $18,000,000 to be entrusted to a non-partisan board of not less than four members selected with a view to their fitness, the board to be guided by competent engineers. The Board of Review, consisting of Wynkoop Kiersted, chairman; Clinton S. Burns, of Burns & McDonnell; George A. Johnson, of Johnson & Bernham; Alexander Maitland, Jr., and John Prince, advises: An intake, pumps and purification works on the Missouri River, near the Platte-Clay County line in Missouri; a new high-service pumping station on Nicholas Ave.; pressure tunnels from the new river station to the present Turkey Creek high-service pumping plant and to the proposed new high-lift station in the East Basin. The board's report has been approved by George W. Fuller, of Fuller & McClintock and is said to meet with approval of the Mayor and the Fire and Water Board.

New York Section of Civil Engineers Advances Meeting Date

Normally the New York Section of the American Society of Civil Engineers meets on the third Wednesday. Because of the annual meeting of the society, however, the next meeting of the section will be held Jan. 12. This date was also announced in the original program and special attention was called to it because it does not follow the usual rule of the third Wednesday meetings. The subject to be discussed is "Water Supply and Sanitation."

Lethbridge To Have City Manager

A change from the commission to the commission-manager plan of government was authorized on Dec. 14 by the voters of Lethbridge, Alberta, Canada.

Highway Education Committee Appoints Director

C. J. Tilden, professor of engineering mechanics at Yale University, has been granted leave of absence for a year to accept the position of director of the highway and highway transport education committee, of which Dr. P. P. Claxton, United States Commissioner of Education, is chairman. The committee, which was formed last May at the invitation of the Commissioner of Education, in addition to Dr. Claxton, includes Thomas H. McDonald, chief of the U. S. Bureau of Public Roads; Col. Mason M. Patrick, Corps of Engineers, U. S. A.; Roy D. Chapin, president of the Hudson Motor Car Co.; W. S. Keller, president, American Association of State Highway Officials; H. S. Firestone, of the Firestone Tire Co.; Dean Bishop, of the University of Pittsburgh, and Prof. Tilden.

The work planned by the committee includes the compilation of economic, scientific and engineering data relative to highway construction and highway transport, and the distribution of these data to educational institutions.

Agree on $100,000,000 for Federal Aid Roads

As a result of an executive meeting of the roads committee of the House of Representatives at Washington, D. C., it was announced on Dec. 22 that Republican leaders have agreed upon an appropriation of $100,000,000 for federal-aid roadwork. This money, it is understood, will be appropriated on the same basis as previous federal-aid funds; that is, the amounts will have to be matched by an equal sum appropriated by the states and the funds are to be distributed on both a population and area ratio. If the following three years are provided for on the same basis, this appropriation will permit of the execution of road development work as planned in the Chamberlain bill.

Connecticut Plans Increase in Motor Vehicle License Tax

According to a recent announcement made by the motor vehicle commissioner of Connecticut, complete revision of auto registration fees is planned. It is possible that the revised schedule will be placed before the legislature early in its session which begins Jan. 5. Essential points in the revised schedule include an increase in all registration fees so that the total collected will be approximately $3,000,000 per year instead of $1,800,000, the total for the fiscal year ending June 30, 1920. A new rating for passenger cars on the basis of horsepower and speed is contemplated.

Paul L. Wolfel

With the death last week of Paul L. Wolfel, chief engineer of the McClintic-Marshall Co., of Pittsburgh, one of the foremost bridge engineers of the day passed away. He died at Philadelphia on Dec. 28, after an illness of several months.

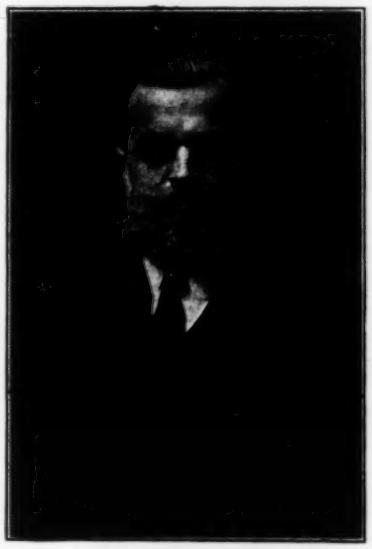
Born in Dresden, Saxony, on April 19, 1861, Paul Ludwig Wolfel studied civil engineering at the Dresden Polytechnikum, graduating in 1885. Two years after graduation he came to the United States. Here he met C. C. Schneider, chief engineer of the Pencoyd Iron Works (A. & P. Roberts Co.), and entered the bridge and construction department of that company.

In 1890 Mr. Wolfel became assistant chief engineer of Pencoyd, and he occupied this position until the company was merged in the American Bridge Co., ten years later. One of the policies which he put into practice during this period and consistently adhered to in his later life was the development of young men who came under his direction. The apprentice course offered in the Pencoyd drafting room produced many engineers who credit their success to his early guidance. His interest in his fellows also revealed itself in many other ways, as in his becoming one of the founders and principal supporters of the Pencoyd Club. The important engineering works with whose design and construction he was connected during these ten years include the Pennsylvania R.R. bridge over the Delaware River at Delair, Penn., and the Atbara bridge in the Sudan, the latter erected by Pencoyd with its own forces.

Upon the formation of the American Bridge Co. in 1900 Mr. Wolfel was made chief engineer, Mr. Schneider becoming vice president in charge of engineering. In 1905, after a period of ill health, he became consulting engineer to the company, remaining in this position until June 30, 1908, when he resigned to assume the duties of chief engineer of the McClintic-Marshall Co. Marshall Williams, assistant to the president of the American Bridge Co., writes, "Mr. Wolfel's active connection with the Pencoyd Iron Works and the American Bridge Co. was ever signalized by a high type of intelligent administration. He was thorough in research, careful in analysis, honest in execution, fair-minded toward his colleagues, and evinced a brotherly interest in the men who served under him. As consulting engineer for the American Bridge Co. his outstanding work was done in connection with the company's part in the reconstruction of San Francisco.

Mr. Wolfel became chief engineer of the McClintic-Marshall Co. at the time of the construction of the Ohio River bridge at Beaver, Penn., for the Pittsburgh & Lake Erie R.R., of the New York Central Lines. This great structure was the first large cantilever to be built after the disaster to the first Quebec bridge, and unusual care was given to its design, fabrication and erection. Because of its magnitude and carrying capacity, unusual study was given to perfecting its details of construction, in which work Mr. Wolfel's experience and clearsighted constructive ability were invaluable. The Beaver bridge as a result marked a distinct advance in bridge engineering.

In the fabrication and erection of the 46 pairs of mitering lock gates for the



PAUL L. WOLFEL

Panama Canal, the largest ever constructed, Mr. Wolfel's guidance contributed to the successful completion of the work by the McClintic-Marshall Co., this at the time depresented probably the largest tonnage of structural steel work ever contracted for at one time.

Among the great bridges constructed by the company under his supervision were the viaducts and various crossings of the New York Connecting R. R. (Hell Gate line) on Long Island and in the Bronx; the Fratt bridge over the Missouri River at Kansas City, and the Sciotoville bridge of the Chesapeake & Ohio Northern Ry. over the Ohio. He was called as a consulting expert by the board of engineers appointed to decide on the type of construction of the second Quebec bridge over the St. Lawrence River.

Mr. Wolfel's work ever expressed his desire for the advancement of the art of steel bridge construction in excellence and stability. He enjoyed the confidence of the engineering profession to an unusual degree. Whatever was placed in his hands was treated with care, thoroughness and absolute integrity of purpose to achieve the best possible result. In his relations with younger men he pointed the way to a fixed aim for reliable work and a high professional standard.

Hoover Represents Engineers on Commerce Committee

American participation in the International Chamber of Commerce became fully organized last week with the appointment of an American committee composed of 57 of the leading business men of the country. The engineering interests are represented by Herbert C. Hoover, president of the American Engineering Council of the Federated American Engineering Societies.

Want State Engineer for Indiana Drainage

The Indiana Department of Conservation will request the legislature to appropriate $30,000 for the maintenance of a state engineer and staff to supervise drainage and similar work in Indiana. The engineer would be required to provide information and to advise courts and county commissioners in regard to drainage projects and reclamation work. A bill has been prepared to create the state division of engineering as a part of the conservation department.

Automotive Engineers Announce Highway Session

At its annual meeting in the Engineering Societies Building in New York City next week the Society of Automotive Engineers on Jan. 13 will inaugurate a "Highway Session" as the first step toward co-operation between the automotive and the civil engineer in the solution of the highway problem. The program includes the following papers: "Government Highway Research," by A. T. Goldbeck, U. S. Bureau of Public Roads; "Variable Factors that Influence Highway Design," by H. Eltinge Breed, consulting engineer; and "Automobile Roads," by W. E. Williams.

Licensing Bill in Tennessee

At a joint dinner of the Memphis Chapter of the American Association of Engineers and the Memphis Engineers' Club on Dec. 20, given in honor of a delegation of state legislators, the lawmakers were informed of the contents of two bills prepared for introduction before the recent session of the legislature. One provides for a department of sanitary engineering in the state board of health and the other for the licensing of engineers and architects. Several prominent engineers and architects spoke in favor of both bills.

River and Drainage Conference

A joint conference of the Mississippi Valley Association and the National Drainage Congress is to be held Jan. 19 and 20 at the Harrington Hotel, Washington, D. C., to discuss means of promoting river regulations, flood control, hydro-electric development and drainage of swamp lands. It is planned also to take up these subjects with congressional committees and department heads.

Cement Producers and Employers' Association Under Fire

In winding up its investigation of the housing situation in New York City the Lockwood joint legislative committee, which ceased to exist Jan. 1 upon the expiration of the 1920 legislature, directed its attack against the cement producers, and against the Building Trades Employers Association, of New York City. Terra cotta producers were also under fire from the committee's counsel, Samuel Untermyer, evidence being introduced to show that there was an interchange of information in advance of bids among the nine members of the Eastern Terra Cotta Association.

Though the Lockwood committee ceased to exist, it is probable that a similar committee will be authorized by the new legislature, inasmuch as the report of Mr. Untermyer indicates that there are many alleged corrupt practices in the building industry still to be brought to light. It is possible, therefore, with favorable action for the continuance of the committee, hearings will again be resumed toward the middle of January.

Control of the cement field and price fixing on the part of the Cement Manufacturers' Protective Association, an organization of nineteen producers with a total annual output of approximately 28,000,000 bbl., were indicated in the testimony given before the committee. Testimony was also given to the effect that the association employed a complex card system wherein twenty-eight different forms were used and which furnished the basis for an alleged method of exchange of information among association members as well as among the members of other regional organizations. In addition, it was testified that six inspectors were employed to determine if prospective jobs needed as much cement as dealers had ordered. In accordance with contract forms submitted by manufacturers to dealers, the latter were forced to return all cement in excess of that actually used for any specific job.

Evidence was also brought out that upon a quarterly report of 630 transactions, ending Sept. 1, 1920, in Brooklyn, it appeared that in each of the sales, ranging in amount from 200 bbl. to 55,000 bbl. the price was in every case $2.65 a barrel. The testimony of the manufacturers was to the effect that cement prices were uniform, because cement is a standard product.

The attack upon the Building Trades Employers Association was directed against Otto M. Eidlitz, a member of the board of governors of the association, and a prominent New York builder. The committee's counsel introduced letters and minutes of the association in an attempt to show that as a result of the organization's close alliance with the Building Trades Council it dominated the building industry, forcing subcontractors and builders in general to seek membership in the association through its control (indirectly through the Building Trades Council) over the supply of labor. The association drew additional fire from the committee's counsel because of its failure to expel from the association those trade-association members whose alleged corrupt practices had been revealed by the Lockwood committee.

Sand Dealers Indicted by Federal Grand Jury

As a result of investigation brought out by the Lockwood committee, investigating housing conditions in New York City, indictments against fifteen firms and individuals alleged to have been in control of the sand and gravel situation in the New York district were returned by the Federal grand jury Dec. 29. Four firms and eleven individuals are included in those indicted for violation of the Sherman anti-trust law, the elimination of competition and conspiracy to monopolize the trade in a certain product.

The firms named are: the Goodwin-Gallagher Sand and Gravel Corporation, Manhattan Sand Co., Inc., Lenox Sand and Gravel Co., Inc., and the Colonial Sand and Stone Co., Inc., and various individual officers of these companies.

Brindell, Indicted Labor Leader, Refused Change of Venue

Robert P. Brindell, president of the Building Trades Council, New York City, and seven times indicted on charges of extortion and attempted extortion as a result of investigation brought out by the Lockwood committee on housing, has been denied a change of venue. The plea entered by Brindell's attorney, on which he sought a change of venue, was based upon the claim that his client could not get a fair trial in New York county because Judge Mulqueen, in General Session, had referred to Brindell as a felon.

Bethlehem Steel Company Reduces Wages

A general reduction in wages of from 10 to 20 per cent in all plants operated by the Bethlehem Steel Co., Baltimore, was announced Jan. 2 by its general manager. The decrease is effective Jan. 16. Wages of common labor will be reduced the full 20 per cent. In normal times the company employs from 5,000 to 6,000 men.

Foreign Firms Invited to Bid on Portugal Port Improvement

About $5,000,700 was recently made available for the improvement of the port of Leixoes (the seaport of Oporto) Portugal, says *Commerce Reports*. Work is to be begun soon and the present intention is to invite foreign bids, contractors to finance the work and to be repaid in bonds guaranteed by port receipts. Further information may be secured from the U. S. consular office at Oporto.

Cement and Hollow Tile Drop in Price

Cement dealers in the New York district announced a further decrease of 30 cents per barrel, without bags, Jan. 4. The drop is reported to be the result of keen competitive selling. Hollow tile also dropped slightly, as announced from the Perth Amboy, N. J., plant, the same day.

Brick on Order Only 41 Per Cent of That in Stock

According to a recent digest circulated by the Common Brick Manufacturers' Association of America reports received from 134 brick manufacturers in ten districts indicate that on Dec. 1, 1920, brick orders represented but 41.5 per cent of brick in stock. The total production of the 134 firms reporting is given as approximately 300,000,000 brick with orders for 123,000,000. The digest continues to say that the excess of 175 000,000 brick on hand over orders would not be serious if there were any demand, but this surplus will be increased rather than diminished during the next three months, as the small proportion of plants operating produce more than the current consumption.

A slight reduction in price is noted, averaging about $2 per thousand in the localities where lower coal prices have taken effect. In all other sections the price at plant remains the same as of Nov. 1.

New York State Builders to Hold Convention in February

The twenty-fifth annual convention of the New York State Association of Builders is to be held in Rochester, N. Y., Feb. 1 and 2, 1921. Rochester was chosen as the meeting place and the date for the convention was fixed at a recent meeting of the officers' conference of the association held in New York City. The association, through the officers' conference, has offered its services to the Lockwood Joint Legislative Committee which is investigating housing conditions in New York City, a special committee having been appointed for that specific purpose.

Abandon Large Co-operative Office Building Project

The Weaver-Crawford Corporation, New York City, has announced that owing to the continued money stringency and the sudden curtailment of business expansion it had not received a sufficient number of subscriptions to warrant the erection of the Park-Madison Building, which was planned to cover three blocks in the Grand Central Terminal area, announcement of which was noted in *Engineering News-Record*, Sept. 9, 1920. As its option with the New York Central R.R. for the blocks on which the building was to have been erected expires Jan. 11, 1921, it was not thought wise to proceed with the project.

Court Forbids Construction of Seattle Reservoir

In a decision handed down recently by the Superior Court, the city of Seattle, Wash., was enjoined from constructing the proposed second reservoir in Volunteer Park as an adjunct to the city water system. The case has been bitterly fought in the courts, suit to restrain the city having been brought by a group of Capitol Hill property owners who objected to the construction on the ground that it would be a menace to their lives and property and destroy the beauty of the park. The Capitol Hill district contains the most expensive and choicest residence property in the city. Hydraulic engineers from all sections of the country were brought to testify for the plaintiffs, and the city also spared no effort to obtain the most expert testimony.

Judge Clay Allen, in handing down his decision, maintained that construction of the proposed reservoir would create in the minds of the complainants fear as to the safety of their homes and that the project would become in legal effect a nuisance. Much of the expert testimony related to the probable amount of leakage from the proposed reservoir.

Shop Council Plan for Chicago Gas Company

According to a recent announcement made by the Peoples Gas Light & Coke Co., of Chicago, a "constitutional convention" of its employees is to be called to plan a system of co-operative management dealing with questions of pay, hours, rules, working conditions and any other debatable matter arising between employer and employee. The workers soon will hold a departmental election to select delegates to the convention at which a plan will be devised. One delegate for every fifty employees is allowed, the management having equal representation with the employes in the assembly. The plan at first is to be offered to the non-unionized departments, including about 2,500 workers, as the unionized branches have the usual contracts with the company. Later, opportunity will be given unionized departments to join in.

American Designed Machinery for Japanese Dam

A commission to design flood and outlet control machinery for the Uji River dam being built by Japanese power interests has been received by F. Teichman, consulting engineer, Boston, Mass. The dam will have a spillway crest with Taintor gates and two gate towers, each with an inner 12-ft. diameter cylinder gate (service gate) and an outer cylindrical emergency gate. Both gate towers will discharge into a 16-ft. diameter tunnel that serves as a bypass during the construction of the dam. The joint capacity of the two gate towers will be from 8,000 to 10,000 cu.ft. per second. The water will carry sand.

A. G. C. Announces Tentative Program for Convention

According to a tentative program recently announced for the second national conference of the Associated General Contractors of America, to be held in New Orleans, Jan. 25-27, inclusive, prominent discussion is to be given industrial issues in which the contractor is especially interested.

The morning of the first day of the meeting will be taken up mostly with routine. In the afternoon the contractors will break up into the various sections: Building contractors, highway contractors, railroad contractors and public works contractors. Special questions affecting these various fields which are to be discussed include the closed and open shop, Federal control of highway construction, the rehabilitation of the railroads, and interpretation of government contracts. On Jan. 27 at the morning session all divisions will consider compensation insurance. Other topics which will be discussed include housing, cement, railroad contractors' costs and the proposed Federal Department of Public Works. Various social features have been provided during the convention.

Denver Contractors to Join with A. G. C.

Denver contractors and engineers recently organized with a view to associating themselves with the Associated General Contractors of America. The Denver contractors will send representatives to the New Orleans meeting of the association, Jan. 25-27.

Road Contractors in West Virginia Form Organization

Road contractors from various sections of West Virginia and Ohio met in Wheeling Dec. 27 and organized the West Virginia Road Building Contractors Association. Temporary officers elected were: J. P. Mumaw, president, and T. J. Bartrue, secretary and treasurer.

Federal Building and Housing Bureau Proposed

Senator Calder, of New York, is the author of a recently introduced bill proposing the creation of a bureau of building construction and housing to be incorporated within the U. S. Department of Commerce. The bureau would function as a clearing house for all construction information.

U. S. Needs 1,250,000 Houses

According to recent estimates made by the civic development department of the U. S. Chamber of Commerce there exists a shortage of approximately 1,250,000 houses in the United States. It is also estimated that but 70,000 houses were built in the United States during 1919, while an even smaller number may prove to have been erected in 1920.

Hold Up Appropriation for Wilson Dam

By failing to include in the sundry civil bill any appropriation for the continuance of the work on the Wilson dam, at Muscle Shoals, on the Tennessee River, the committee on appropriations of the House of Representatives has precipitated an acrimonious controversy which promises to last throughout the session and may prevent the passage of the entire bill. The appropriation was withheld on the ground that the policy of the government with regard to this development has not been agreed upon. There is opposition to the proposed operation of the nitrate plants at Muscle Shoals. Those favoring the continuance of the work and the operation of these plants wield much influence and an effort will be made to override the committee and provide for sufficient funds to keep the work going.

Aid Skilled Help in Slack Times, Says Kansas Court

Employers of workmen in essential industries in Kansas must arrange to take care of skilled and faithful employees during times of depression, according to a recent decision by the Kansas Court of Industrial Relations. The decision was the result of a complaint brought by employees against the Topeka flour mills, which recently closed down to about half capacity as a result of the general depression in industry.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City, Jan. 19-20, 1921.

AMERICAN CONCRETE INSTITUTE, Detroit; Chicago, Feb. 14-16.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; New Orleans, Jan. 25-27.

ENGINEERING INSTITUTE OF CANADA, Montreal; Toronto, Feb. 1-3.

The Western Society of Engineers' January program schedules ten meetings, among which are the following: Jan. 10, "Reducing the Cost of Steel Buildings," by R. Fleming, engineer, American Bridge Co.; Jan. 12, "Public Utility Rates," by A. S. B. Little, gas engineer, Illinois Public Utilities Commission; Jan. 14, "What Labor Expects of the Engineer," by Thomas R. Preece, vice-president, Bricklayers', Plasterers' and Stone Masons' International Union of America; Jan. 14, "The Tie Supply of the Future," by John Foley, for-

ester, Pennsylvania System; Jan. 17, "Chicago City Water-Works, Past, Present and Future," by P. S. Combs, city engineer. On Saturday afternoon Jan. 8 the Young Men's Forum will hear Samuel H. Moore, director of welfare and pensions, Peoples Gas Light & Coke Co., on "The Engineer from the Human Standpoint," and on Jan. 22 Harwood Frost, president, Brown Portable Conveyor Co., will speak on "Engineering Literature—How to Write—What to Read."

The New Jersey State Association of County Engineers will hold its annual meeting at the Engineers' Club, Trenton, Jan. 25. There will be a business meeting and election of officers from 11 to 12 a.m. At the meeting commencing at 2 p.m. the following papers will be read: "Bridges for New Jersey Roads," by Charles A. Meade, bridge engineer, New Jersey Highway Department; "Some Facts Relating to Motor Vehicle Registration," by William L. Dill, commissioner of motor vehicles; "Testing and Laboratory Control of Large Highway Contracts," by R. B. Gage, chemical engineer.

The New England Waterworks Association will hold its annual meeting at the Copley Square Hotel, Boston, Jan. 12. The program calls for the annual address of the president and for reports from fourteen committees, the secretary and other officers and the tellers appointed to canvass the ballots for officers for 1921. Frank J. Gifford, Dedham, Mass., is secretary.

The American Concrete Institute announces that the annual meeting will be held at the Auditorium Hotel, Chicago, Feb. 14-16. The secretary of the Institute is Harvey Whipple, New Telegraph Building, Detroit, Mich.

The Iowa Engineering Society will hold its annual meeting Jan. 18, 19 and 20 at the Chamberlain Hotel, Des Moines.

PERSONAL NOTES

W. H. FAIRCHILD, formerly city engineer of Galt, Ont., Canada, has been appointed manager of the Galt Public Utilities Commission.

WILLIAM C. BARBER, mayor of Joliet, Ill., has accepted the city managership of Dayton, Ohio, at a salary of $12,000 a year, succeeding James E. Barlow, resigned.

H. T. CARMICHAEL, for the past seven years managing partner of Mason & Hanger Co., Lexington, Ky., has accepted a position as general superintendent, Kentucky Rock Asphalt Co., Bowling Green, Ky., in charge of future development of its 50,000-acre holdings.

CLYDE T. MORRIS of Ohio State University has been appointed engineer on the building of the university stadium, which will seat 63,000 people and will cost $1,000,000. Charles Evan Fowler, New York, has been retained as consulting engineer on the foundations and river improvement.

EDWARD S. CLARK, who has been in the employ of the city of Kalamazoo, Mich., for more than 13 years, during which time he has had charge of practically all branches of the engineering department, has been appointed city engineer.

RICHARD D. PARKER, chief engineer of the Railroad Commission of Texas from 1909 to 1920, has been appointed chief engineer of the gas utilities division of the commission.

LOUIS A. GUERINGER, for the past three years assistant engineer of the Railroad Commission of Texas, has been appointed chief engineer. He was for 20 years locating and constructing engineer for the Frisco and other trunk lines in Texas.

JAMES P. HAYS, formerly field superintendent in the Cleveland district for the Austin Co., has been promoted to superintendent of this district with headquarters in Indianapolis.

H. L. NEWMAN has been appointed maintenance engineer of the Pittsburgh, Shawmut & Northern R.R. He has been with this road since 1906, recently in charge of all engineering, including valuation and location.

GEORGE COTTINGHAM, JR., formerly roadmaster Northern Pacific Ry., with headquarters at Carrington, N. D., has been appointed engineer maintenance of way, Eastern Division, Chicago, Great Western R.R., with headquarters at Chicago.

W. A. HENDRY has been appointed chief water-works engineer of Waterloo, Iowa.

JOHN STORM has been appointed engineer of the water-works plant of the Public Service Co. at Mattoon, Ill.

P. Y. K. HOWAT, civil engineer, president of P. Y. K. Howat, Inc., engineers and contractors of Annapolis, Md., has recently been instrumental in organizing a Rotary Club in that city. Mr. Howat was elected president; Henry P. Hopkins, an architect, vice-president, and Walter C. Munroe, another civil engineer, was made a director.

MELVIN E. HIET has accepted the position of engineer of Nowata County, Okla., in addition to his present position of engineer for Pawnee County.

PHILIP L. PRATLEY of Montreal, Canada, has been awarded the Telford gold medal of the Institution of Civil Engineers of Great Britain for his paper, "The Design and Erection of the St. John Arch." Mr. Pratley is at present in charge of the Montreal office opened some time ago by the Department of Railways and Canals in connection with the Grand Trunk arbitration.

P. J. MUNDY has been appointed city manager of Radford, Va.

H. L. WILSON has been appointed city engineer of Johnstown, Pa.

J. E. HUBER, district engineer, Illinois Department of Public Works and Buildings, Division of Highways, since 1913, has resigned to accept a position with the Western Wheeled Scraper Co., Aurora, Ill.

THOMAS F. KENNEDY, civil, sanitary and mining engineer, has entered private practice in engineering, associating with J. H. Rittenhouse & Son, consulting engineers, with offices at Scranton, Pa.

A. W. A. EDEN, for five years assistant structural engineer with Westinghouse, Church, Kerr & Co., Inc., has accepted a position with the Harris Structural Steel Co., New York.

OBITUARY

COLIN CAMPBELL, president of the National Hoisting Engine Co., Harrison, N. J., died Dec. 26, at Newark. He was born in Scotland and was 67 years old. He learned the trade of machinist. In 1887 he came to America and worked for J. S. Mundy until 1903, when he entered business for himself.

BENJAMIN HOLT, president of the Holt Manufacturing Co., died at Stockton, Cal., Dec. 5. He had been constantly engaged in inventive and creative work connected with caterpillar tractors, harvesters, and other machines originally invented by him, and being manufactured in the Holt plants. He was born in Merrimac County, N. H., Jan. 1, 1849. He went to California in 1883, at which time he and Charles H. Holt took up the manufacture of wagon wheels at Stockton, first under the name of the Stockton Wheel Co. In 1892 the Holt Manufacturing Co. was incorporated at Stockton. Benjamin Holt was the inventive genius of the organization, and his name has become known throughout the world as a pioneer in the design and building of new types of agricultural and road machinery. Due to his work the caterpillar was established as a commercial success and was available for military needs with the outbreak of the war in 1914, when it was adopted by the Allied Governments for artillery and supply transportation. Those tractors brought about the creation of "tanks," and Benjamin Holt has been given credit as the inventor of the caterpillar tractor, which made the tanks possible.